VOLUME XXV
NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

FEBRUARY, 1914

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CONTENTS

16 Pages of Photogravure
Wayside Scenes in Europe

MAP OF ALASKA, in Three Colors
15¾ x 20 INCHES

Battling with the Panama Slides
WITH 15 ILLUSTRATIONS
WILLIAM JOSEPH SHOWALTER

The Panama Canal
WITH 22 ILLUSTRATIONS
COL. WILLIAM L. SIBERT, U. S. A.

The Nation's Undeveloped Resources
WITH 32 ILLUSTRATIONS
FRANKLIN K. LANE
Secretary of the Interior

Probable Effect of the Panama Canal on Commercial Geography
O. P. AUSTIN

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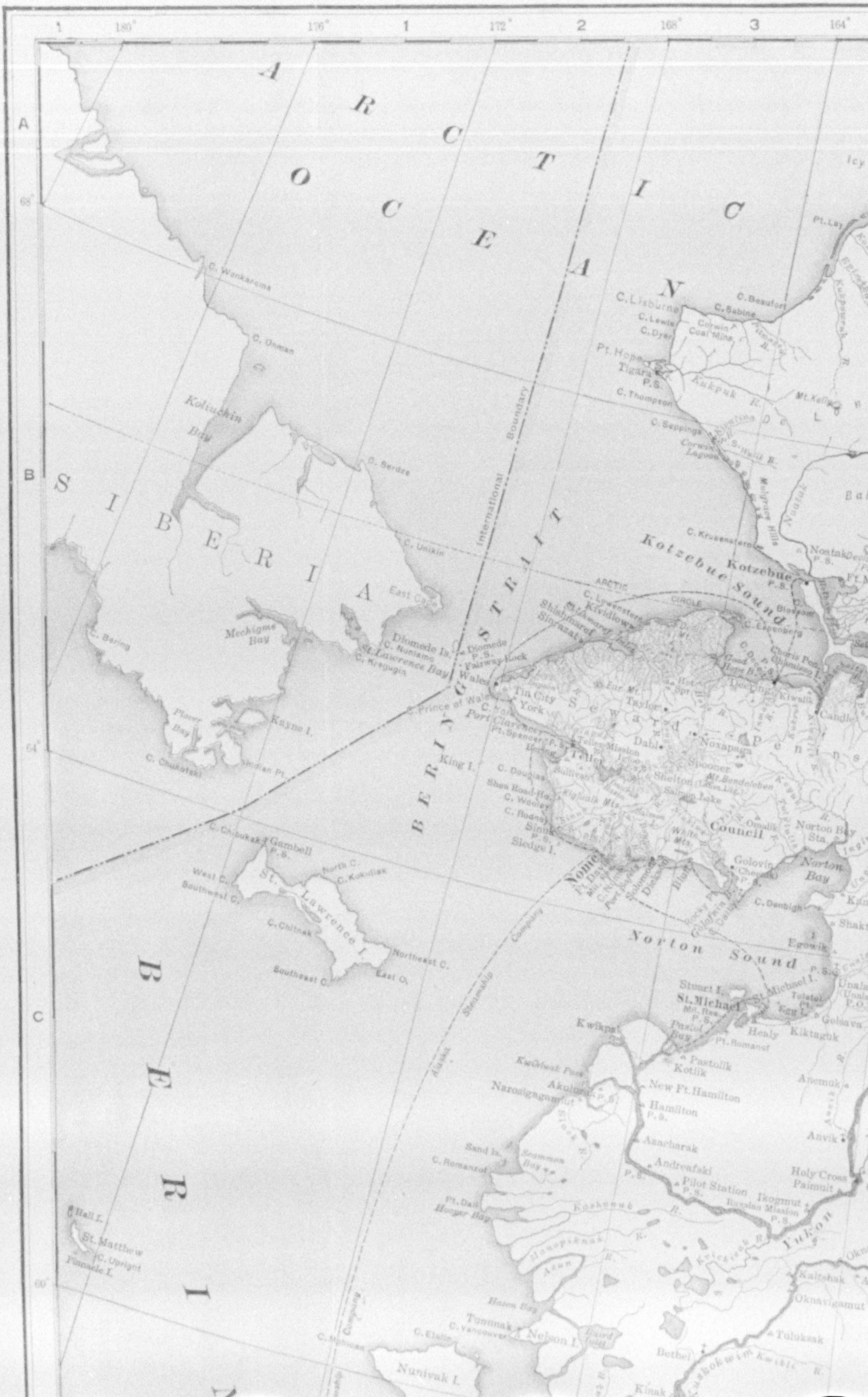
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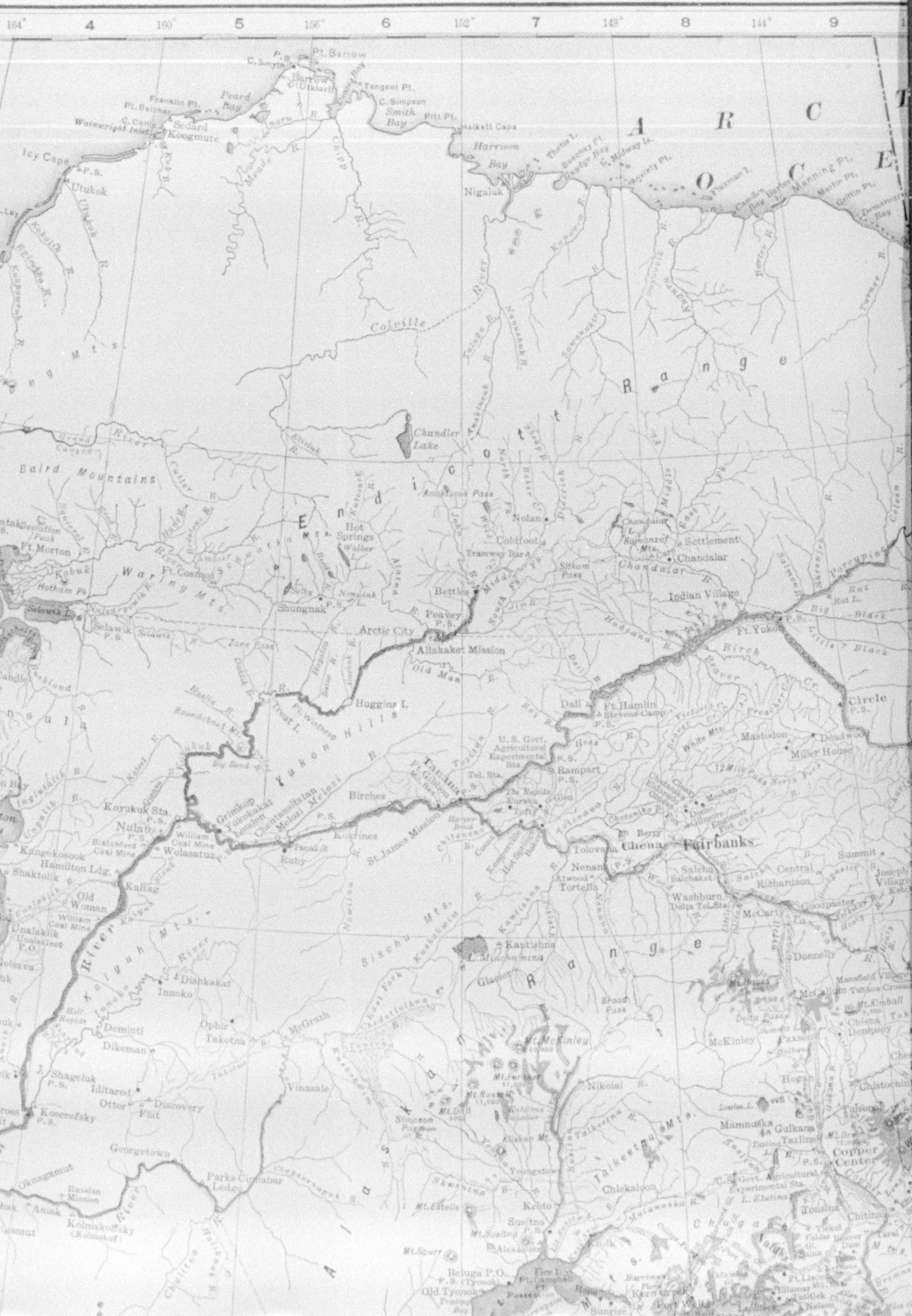
ARCTIC OCEAN
SIBERIA
BERING STRAIT
BERING SEA
International Boundary
ARCTIC CIRCLE
C. Wankaroma
C. Onman
Koliuchin Bay
C. Serdze
C. Unikin
East Cape
Mechigme Bay
C. Bering
Diomede Is.
Diomede P.S.
Fairway Rock
C. Nuniamo
St. Lawrence Bay
C. Kreguigin
C. Prince of Wales
Wales
Plover Bay
Kayne I.
C. Chukotski
Indian Pt.
C. Chibukak
Gambell P.S.
North C.
C. Kokidlak
West C.
Southwest C.
St. Lawrence I.
C. Chitnak
Northeast C.
East C.
Southeast C.
Hall I.
St. Matthew
C. Upright
Pinnacle I.
C. Lisburne
C. Lewis
C. Dyer
C. Sabine
C. Beaufort
Corwin Coal Mine
Pt. Hope
Tigara P.S.
C. Thompson
Kukpuk R.
Mt. Kelly
C. Seppings
Corwin Lagoon
Mulgrave Hills
Noatak
Pt. Lay
Icy
C. Krusenstern
Kotzebue Sound
Kotzebue P.S.
Noatak P.S.
C. Lowenstern
Kividlow
Shishmaref Inlet
Sinrazat
C. Espenberg
Choris Pen.
Chamisso I.
Good Hope Bay
Deering
Kiwalik
Candle
Tin City
York
Port Clarence
Pt. Spencer
Teller Mission
Teller
King I.
C. Douglas
Shen Road Ho.
C. Wooley
C. Rodney
Sinuk
Sledge I.
Mt. Taylor
Dahl
Noxapaga
Seward Peninsula
Spooner
Shelton
Mt. Bendeleben
Salmon Lake
Council
Kigluaik Mts.
White Mts.
Omalik
Norton Bay Sta.
Norton Bay
Golovin
Cheenik
Nome
Pt. Davis
Solomon
Dickson
Bluff
Rocky Pt.
Golovnin Bay
C. Denbigh
Shaktolik
Egowik
Norton Sound
Stuart I.
St. Michael
St. Michael I.
Mil. Res. P.S.
Egg I.
Unalaklik
Pastol Bay
Pt. Romanof
Healy
Kiktaghk
Kwikpak
Pastolik
Kotlik
Kwikluak Pass
Akulurak
Narosigagamut
New Ft. Hamilton
Hamilton P.S.
Black R.
Sand Is.
Scammon Bay
C. Romanzof
Azacharak
Andreafski
Pilot Station P.S.
Anvik
Anvik R.
Holy Cross
Paimut
Ikogmut
Russian Mission P.S.
Yukon
Pt. Dall
Hooper Bay
Kashunuk R.
Kaltshak
Oknavigamut
Hazen Bay
Tununak
C. Vancouver
Nelson I.
C. Etolin
C. Mohican
Nunivak I.
Bethel
Tuluksak
Kuskokwim R.
Kwikak
Kinak
Alaska Steamship Company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C. Smyth
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Tangent Pt.
C. Simpson
Smith Bay
Pitt Pt.
Peard Bay
Franklin Pt.
Pt. Belcher
C. Collie
Wainwright Inlet
Sedard
Koogmute
Inaru R.
Chipp R.
Meade R.
Kuk R.
Halkett Cape
Harrison Bay
Nigaluk
Thetis I.
Beechey Pt.
Gwydyr Bay
Midway Is.
Foggy Is.
Flaxman I.
Camden Bay
Barter I.
Manning Pt.
Martin Pt.
Griffin Pt.
Demarcation Bay
A R C T
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P.S.
Utukok
Utukok R.
Kokolik R.
Kukpowruk R.
Colville
River
Itkillik R.
Kuparuk R.
Sagavanirktok R.
Canning R.
Hulahula R.
Kongakut R.
Turner R.
Anaktuvuk R.
Chandler Lake
E n d i c o t t R a n g e
Baird Mountains
Grand Canyon
River
Cutler R.
Noatak
Delcoltion Peak
Ft. Morton
Kobuk
Hotham Pk
Squirrel R.
Selawik L.
Selawik
P.S.
Selawik R.
Waring Mts.
Ft. Cosmos
Ambler R.
Kobuk
Schwatka Mts.
Hot Springs
Walker
Reed R.
Selby
Shungnak
Nomuink L.
P.S.
Alatna R.
Anaktuvuk Pass
John R.
Wild R.
Nolan
Coldfoot
Tramway Bar
Bettles
Middle Fk.
South Fk.
Peavey
P.S.
Arctic City
Allakaket Mission
Old Man R.
Chandalar L.
Romanzof Mts.
Settlement
Chandalar
Chandalar R.
Sitkum Pass
Indian Village
Middle Fk.
East Fk.
Hodzana R.
Ft. Yukon
P.S.
Porcupine R.
Rat R.
Rat L.
Big Black
Little Black
Sheenjek R.
Salmon R.
Coleen R.
Birch Cr.
Beaver Cr.
Preacher Cr.
Circle
P.S.
Mastodon
Deadwood
Miller House
Dall R.
Dall
Ft. Hamlin
Stevens Camp
P.S.
Victoria Cr.
White Mts.
Hess R.
U.S. Govt. Agricultural Experimental Sta.
P.S.
Rampart
P.S.
12 Mile Pass
North Fork
Huggins I.
Pt. Winthrop
Treat I.
Roundabout Mt.
Hughes R.
Yukon Hills
Koyukuk
Big Bend
Kateel R.
Dulbi R.
Koyukuk Sta.
P.S.
Nulato
P.S.
Grimkop
Yukokakat
Louden
Chentansitzan
Melozi
Melozi
Ft. Gibbon
Tanana
P.S.
Tel. Sta.
Tozitna R.
Birches
P.S.
Kokrines
Ruby
St. James Mission
The Rapids
Eureka
Tofty
Glen
Baker Hot Springs
Chitanana R.
Cosna R.
Kantishna R.
Tolovana
Chena
P.S.
Fairbanks
Berry
Cleary
Chatanika
Olnes
Dome
Gilmore
Meehan
Engineer
Fox
Chena R.
Nenana
Atwood
Tortella
Nenana R.
Wood R.
Salcha
Salchaket
Central
Richardson
Washburn
Delta Tel. Sta.
McCarty
Goodpaster
Summit
Joseph Village
Ketch
Tanana
Donnelly
Kangokosook
Shaktolik
Hamilton Ldg.
William Coal Mine
Bixlenford Coal Mine
Wolasatux
Kaltag
Old Woman
William Coal Mine
Unalaklik
Unalakleet
P.O.
Kaiyuh Mts.
River
Innoko
Dishkakat
Innoko
Sischu Mts.
Kuskokwim R.
Kantishna
L. Minchumina
Glamer
R a n g e
Broad Pass
Mt. Hayes
McCallum
Mansfield Village
Tanana Crossing
Mt. Kimball
Delta Pass
Chisna
Dempsey
Paxson
McKinley
Holy Cross
Holt Rapids
Demintl
Ophir
Takotna
McGrath
Dikeman
Shageluk
P.S.
Iditarod
Otter
Discovery
Flat
Koserefsky
P.S.
Vinasale
Mt. McKinley
20300
Mt. Foraker
17,000
Mt. Russell
11,600
Mt. Dall
9000
Kahiltna Glacier
Simpson Pass
Nikolai
Hogan
Chistochina
Louise L.
Gulkana
Mamnuska
Tazlina
Copper Center
P.S.
Talsona
Georgetown
Oknagamut
Russian Mission
Parks Cinnabar Ledge
Chagavenapuk R.
Talkeetna R.
Talkeetna Mts.
Susitna R.
Youngstown
Skwentna R.
Chickaloon
U.S. Govt. Agricultural Experimental Sta.
L. Klutina
Tonsina
Chitina
Mt. Estelle
Kroto
Susitna
P.S.
Mt. Susitna
Alexander
Anik
Kolmakoffsky
(Kolmakof)
Mt. Spurr
Beluga P.O.
P.S. (Tyonok)
Old Tyonok
Fire I.
Pt. Campbell
Possession
Knik
Kern Creek
Hope
Sunrise
Port Wells
Chugach
Valdez
Ft. Liscum
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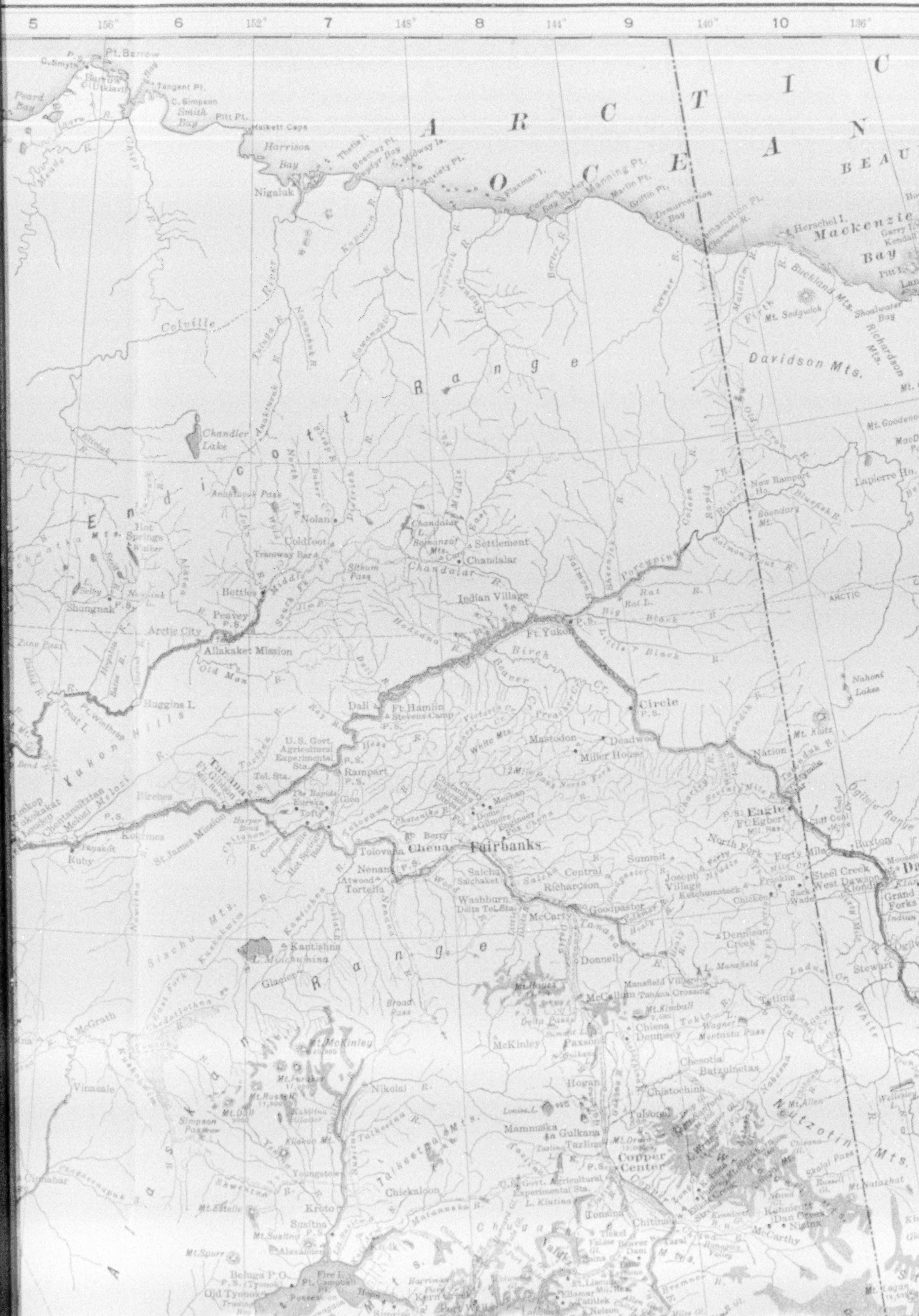5
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A R C T I C O C E A N
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Barrow
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Tangent Pt.
C. Simpson
Smith Bay
Pitt Pt.
Peard Bay
Halkett Cape
Harrison Bay
Nigaluk
Thetis I.
Beechey Pt.
Gwydyr Bay
C. Midway Is.
Anxiety Pt.
Flaxman I.
Camden Bay
Barter I.
Manning Pt.
Martin Pt.
Griffin Pt.
Demarcation Bay
Demarcation Pt.
Herschel I.
Mackenzie Bay
Buckland Mts.
Mt. Sedgwick
Shoalwater Bay
Richardson Mts.
Davidson Mts.
Colville River
Meade R.
Chipp R.
Kuparuk R.
Canning R.
Turner R.
Firth R.
Malcolm R.
Old Crow R.
Endicott Range
Chandler Lake
Anaktuvuk Pass
Hot Springs
Nolan
Coldfoot
Chandalar L.
Settlement
Chandalar
Chandalar R.
Romanzof Mts.
Sithkum Pass
Bettles
Peavey
P.S.
Arctic City
Shungnak
Alatna R.
Koyukuk R.
Allakaket Mission
Old Man R.
Huggins I.
Indian Village
Ft. Yukon
Porcupine R.
Salmon R.
Sheenjek R.
Coleen R.
Rapid R.
New Rampart Ho.
Boundary Mt.
Lapierre Ho.
Mt. Goodenough
Rat L.
Big Black R.
Little Black R.
ARCTIC
Hodzana R.
Birch Cr.
Beaver Cr.
Dall
Ft. Hamlin
Stevens Camp
Ray R.
Circle
Mastodon
Deadwood
Miller House
White Mts.
Nation
Mt. Klotz
Nahoni Lakes
Yukon Hills
Zane Pass
Dulbi R.
Troutl.
Ft. Winthrop
Melozi
Kokrines
Ruby
Tanana
Ft. Gibbon
Tel. Sta.
Birches
U.S. Govt. Agricultural Experimental Sta.
Rampart
Eureka
Tofty
Glen
The Rapids
Hot Springs
Tolovana
Tolovana R.
Chena
Fairbanks
Berry
Chatanika R.
Cleary
Olnes
Gilmore
Dome
Meehan
Engineer
Fox
12 Mile Pass
North Fork
Charley R.
Eagle
Ft. Egbert
Mil. Res.
Seventymile R.
Fortymile
Forty Mile
North Fork
Steel Creek
West Dawson
Klondike
Jack Wade
Franklin
Chicken
Buxton
Ogilvie Range
Grand Forks
Stewart
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Richardson
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Tanana R.
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Dennison Creek
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L. Minchumina
Glacier
Sischu Mts.
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Broad Pass
Mt. Hayes
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Mansfield Village
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Batzulnetas
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Louise L.
Mannuska
Gulkana
Tazlina
Mt. Drum
Copper Center
Mt. Sanford
Mt. Wrangell
Mt. Blackburn
Kluane
Mt. Natazhat
Skolai Pass
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Talkeetna R.
Susitna R.
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Susitna
Mt. Susitna
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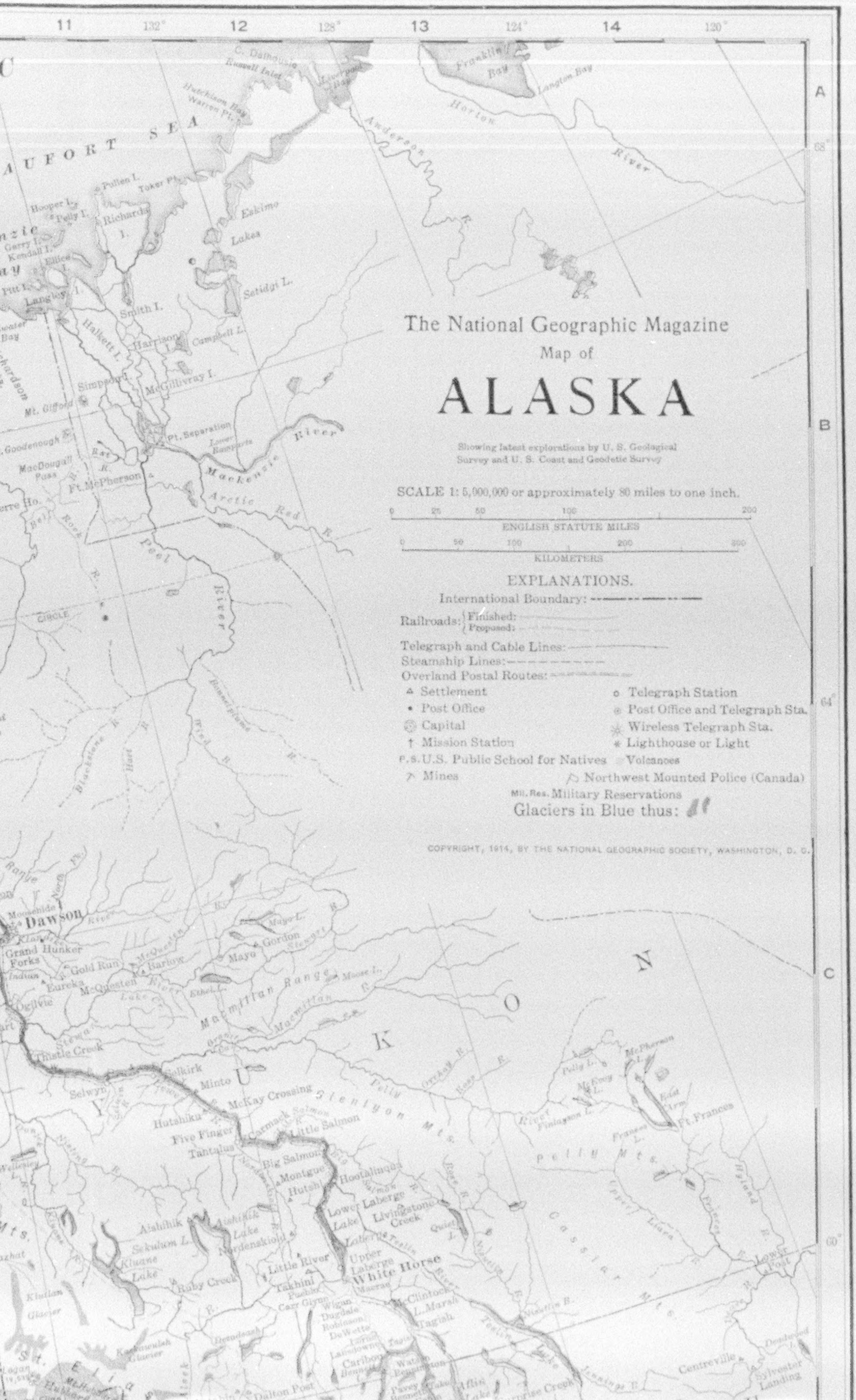
Matanuska R.
Chugach Mts.
Valdez
Tonsina
Tiekel
Beaver Dam
Chitina
Taral
Kennicott
Dan Creek
Nizina
McCarthy
Kuskokwim R.
Kachatna Glacier
Klokon Mt.
Cinnabar
Ft. Liscum
Ellamar
Fatitlek
Port Wells
Knik
Kern Creek
Bremner R.
Mt. Logan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BEAUFORT SEA
Franklin Bay
Langton Bay
Horton River
Anderson R.
Liverpool Bay
C. Dalhousie
Russell Inlet
Hutchinson Bay
Warren Pt.
Eskimo Lakes
Satidgi L.
Pullen I.
Toker Pt.
Hooper I.
Pelly I.
Richards I.
Garry I.
Kendall I.
Ellice I.
Pitt I.
Langley I.
Smith I.
Halkett I.
Harrison I.
Campbell L.
McGillivray I.
Simpson I.
Mt. Gifford
Pt. Separation
Lower Ramparts
Mackenzie River
Arctic Red R.
Goodenough
MacDougall Pass
Rat R.
Ft. McPherson
Bell R.
Rock R.
Peel R.
Peel River
Wind R.
Bonnet Plume R.
Blackstone R.
Hart R.
Arctic Circle
Dawson
Moosehide
Klondike
Grand Forks
Hunker
Gold Run
Indian
Eureka
McQuesten
Barlow
Ogilvie
Mayo
Mayo L.
Gordon
Stewart R.
Macmillan Range
Macmillan R.
Moose L.
Ethel L.
Lake Cr.
Thistle Creek
Granite
Selkirk
Minto
Selwyn
Jewel
McKay Crossing
Hutshika
Five Finger
Tantalus
Carmack
Little Salmon
Big Salmon
Montgue
Hutshi
Hootalinqua
Lower Lake Laberge
Livingstone Creek
Quiet L.
Upper Laberge
Little River
Takhini
White Horse
Macrae
Pueblo
Carr Glynn
Wigan
Dugdale
Robinson
DeWette
McClintock
L. Marsh
Tagish
Caribou
Watson
Pavey
Atlin Lake
Dalton Post
Aishihik
Aishihik Lake
Sekulmun L.
Nordenskiold
Kluane Lake
Ruby Creek
Kluhan Glacier
Kaskawulsh Glacier
St. Elias
Mt. Hubbard
Pelly R.
Orchay R.
Ross R.
Slenlyon Mts.
Pelly L.
McPherson L.
McEvoy L.
Finlayson L.
East Arm
Ft. Frances
Frances L.
Pelly Mts.
Upper Liard
Cassiar Mts.
Hyland R.
Lower Post
Dease L.
Centreville
Sylvester Landing
Teslin
Nisutlin R.
Jennings R.
YUKON

The National Geographic Magazine

Map of

ALASKA

Showing latest explorations by U. S. Geological Survey and U. S. Coast and Geodetic Survey

SCALE 1: 5,000,000 or approximately 80 miles to one inch.

0
25
50
100
200
ENGLISH STATUTE MILES
0
50
100
200
300
KILOMETERS

EXPLANATIONS.

International Boundary: —·—·—

Railroads: { Finished: ——— / Proposed: – – –

Telegraph and Cable Lines: ———

Steamship Lines: – – – – – – – – – –

Overland Postal Routes: ———

- ▵ Settlement
- • Post Office
- ⊛ Capital
- † Mission Station
- P.S. U.S. Public School for Natives
- ⚒ Mines
- ○ Telegraph Station
- ⊙ Post Office and Telegraph Sta.
- ✳ Wireless Telegraph Sta.
- ∗ Lighthouse or Light
- Volcanoes
- ⚐ Northwest Mounted Police (Canada)
- Mil. Res. Military Reservations

Glaciers in Blue thus:

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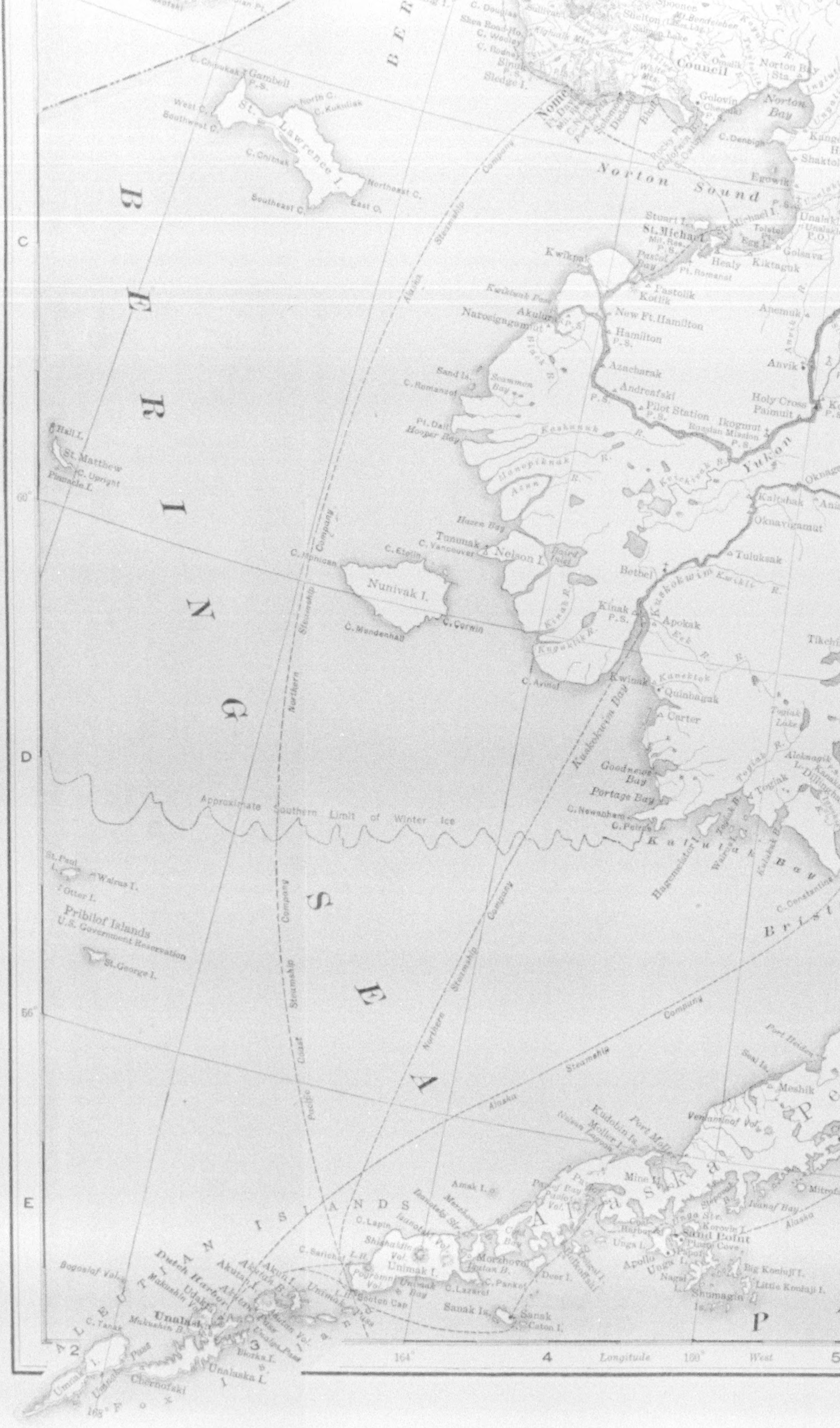
B E R I N G S E A
Norton Sound
Norton Bay
St. Lawrence I.
Gambell P.S.
C. Chibukak
West C.
Southwest C.
North C.
C. Kukuliak
C. Chitnak
Northeast C.
Southeast C.
East C.
C. Douglas
Shea Road Ho.
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Egowik
Shaktolik
Stuart I.
St. Michael
St. Michael I.
Unalaklik
Tolstoi Pt.
Egg I.
Golsava
Healy
Kiktaguk
Pastol Bay
Pt. Romanof
Kwikpak
Pastolik
Kotlik
Kwikluak Pass
Akulurak P.S.
Narosigagamut
New Ft. Hamilton
Hamilton P.S.
Black R.
Anemuk
Anvik
Azacharak
Andreafski
P.S.
Pilot Station
Ikogmut
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Holy Cross
Paimut
Sand Is.
C. Romanzof
Scammon Bay
Pt. Dall
Hooper Bay
Kashunuk R.
Manopiknak R.
Azun R.
Yukon
Kaltshak
Oknavigamut
Hazen Bay
Tununak
C. Vancouver
Nelson I.
Baird Inlet
C. Etolin
C. Nunivak
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C. Corwin
Betbel
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Dillingham
Togiak R.
Kulukak Bay
Walrus I.
Hagemeister I.
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C. Constantine
B r i s t o l
Approximate Southern Limit of Winter Ice
Hall I.
St. Matthew
C. Upright
Pinnacle I.
St. Paul I.
Walrus I.
Otter I.
Pribilof Islands
U.S. Government Reservation
St. George I.
Alaska Steamship Company
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Pacific Coast Steamship Company
Port Heiden
Seal Is.
Meshik
Veniaminof Vol.
Kudobin Is.
Moller I.
Nelson Lagoon
Port Moller
Mine H.
Amak I.
Izembek B.
Morzhovoi
Pavlof Bay
Pavlof Vol.
Cold Bay
A l a s k a
Ivanof Bay
Mitrofania
Unga Str.
Korovin I.
Coal Harbor
Sand Point
Unga I.
Popof I.
Pirate Cove
Apollo
Nagai I.
Shumagin Is.
Big Koniuji I.
Little Koniuji I.
Deer I.
Belkofski
Sanak Is.
Sanak
Caton I.
C. Lapin
Shishaldin Vol.
Unimak I.
Isanotski Str.
C. Sarichef
L.H.
Pogromni Vol.
Unimak Bay
C. Lazaref
C. Pankof
Scotch Cap
Unimak Pass
Akun I.
Akutan I.
Akutan Pass
Dutch Harbor
Unalaska
Unalga Pass
Makushin Vol.
Makushin B.
Bogoslof Vol.
Baby I.
Unalaska I.
Chernofski
C. Tanak
Umnak I.
Umnak Pass
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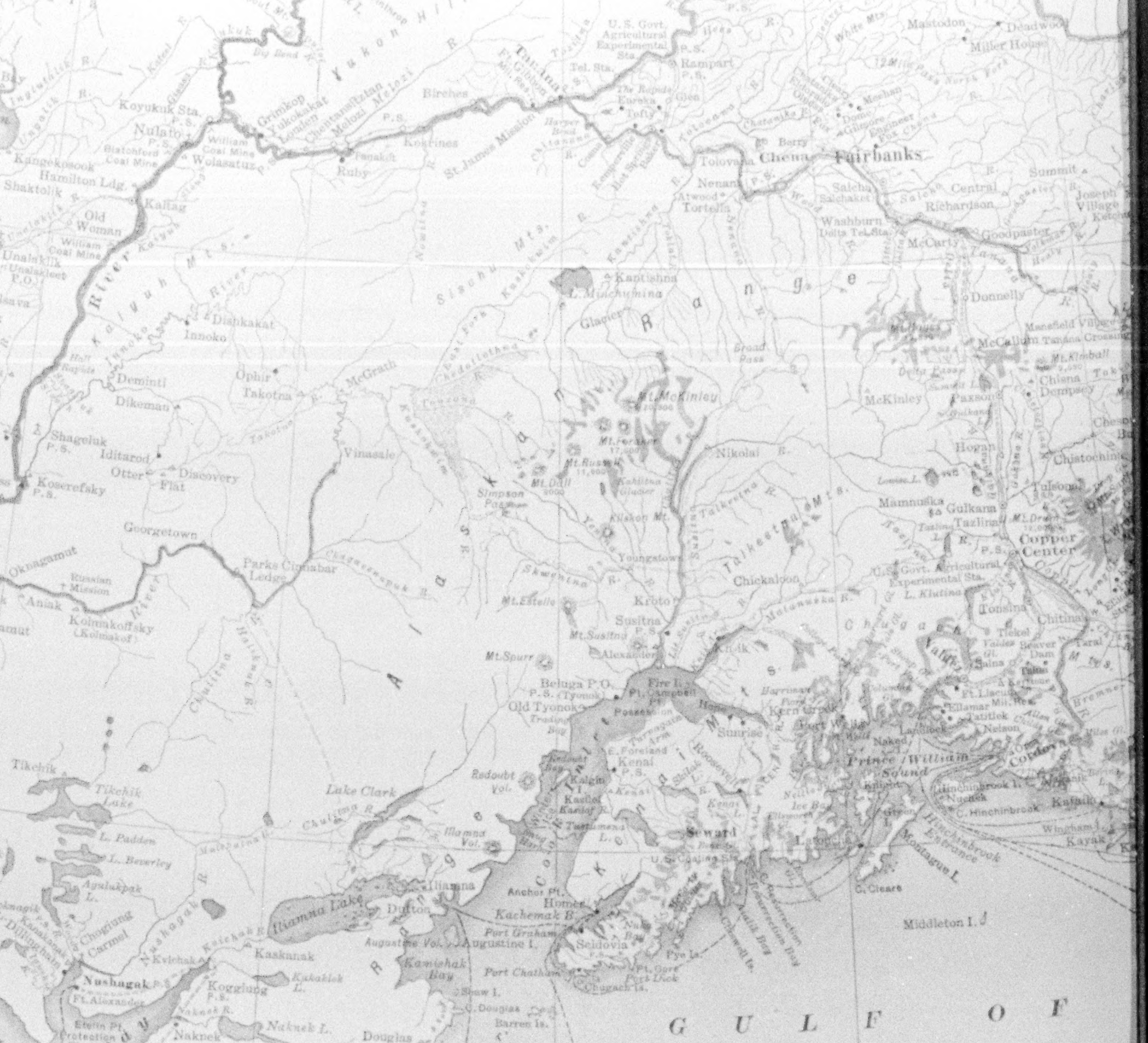
Western Extension of
ALEUTIAN ISLANDS
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ENGLISH STATUTE MILES
Attu I.
Semichi Is.
Near Islands
Agattu I.
C. Wrangell
Buldir I.
Kiska I.
Semisopochnoi
U.S. Government Reservation
Rat I.
Amchitka I.
Rat Islands
Gareloi I.
Tanaga I.
Kanaga I.
Longitude East 176° from Greenwich 180°
5 from 156° Greenwich 6
148
G U L F O F
O C E A
P A C I F I C
Fairbanks
Chena
Tolovana
Nenana
Tortella
Rampart
Tanana
U.S. Govt. Agricultural Experimental Sta.
Mastodon
Deadwood
Miller House
Circle
Salcha
Richardson
Central
Goodpaster
Joseph Village
Summit
McCarty
Donnelly
McCallum
Mansfield Village
Tanana Crossing
Chisana
Dempsey
Paxsons
McKinley
Gulkana
Tazlina
Copper Center
Chitina
Tonsina
Tiekel
Valdez
Ellamar
Cordova
Katalla
Kayak
Wingham I.
Prince William Sound
Hinchinbrook I.
C. Hinchinbrook
Hinchinbrook Entrance
Montague I.
C. Cleare
Middleton I.
Latouche
Seward
Sunrise
Hope
Knik
Kern Creek
Matanuska R.
Chickaloon
Talkeetna Mts.
Susitna
Kroto
Youngstown
Alexander
Beluga P.O.
Old Tyonok
Fire I.
Pt. Campbell
Possession
Kenai
Kasilof
Kalgin I.
Cook Inlet
Kenai Mts.
Homer
Kachemak B.
Seldovia
Port Graham
Port Chatham
Chugach Is.
Pt. Gore
Port Dick
Resurrection Bay
Mt. McKinley
Mt. Foraker
Mt. Russell
Mt. Dall
Mt. Spurr
Mt. Susitna
Mt. Estelle
Redoubt Vol.
Iliamna Vol.
Augustine Vol.
Augustine I.
Iliamna
Iliamna Lake
Lake Clark
Dutton
Kamishak Bay
Shaw I.
C. Douglas
Barren Is.
Pt. Banks
Afognak Forest and Fish Culture Reserve
Afognak I.
Afognak
Marmot I.
Marmot Bay
Kodiak (St. Paul)
Wood I.
Chiniak B.
Kodiak I.
Karluk
Uyak Bay
Eagle Harbor
Sitkalidak I.
Akhiok
Sitkinak I.
Tugidak I.
Trinity Is.
Chirikof I.
Semidi Is.
Taylor
Mitrofania I.
Chignik
Sutkum
Sutwik I.
Aniakchak Bay
C. Providence
Kujulik B.
Alaska Peninsula
Katmai
Kaguyak Vol.
Katmai Vol.
Mageik Vol.
Peulik Vol.
Becharof L.
Ugashik
Ugashik Lakes
Ugaguk
Savonoski
Naknek
Naknek L.
Kogguing
Kaskanak
Kvichak
Kakablok L.
Nushagak
Ft. Alexander
Carmel
Choggiung
Bristol Bay
Tikchik Lake
L. Padden
L. Beverley
Agulukpak L.
Kolmakoffsky (Kolmakof)
Russian Mission
Oknagamut
Aniak
Parks Cinnabar Lodge
Georgetown
Koserefsky
Shageluk
Iditarod
Otter
Discovery
Flat
Vinasale
Takotna
Ophir
McGrath
Dikeman
Demintl
Dishkakat
Innoko
Kaltag
Old Woman
Unalaklik
Shaktolik
Kangekosook
Hamilton Ldg.
Nulato
Koyukuk Sta.
Grimkop
Wolasatuz
Ruby
Birches
Kokrines
St. James Mission
Tofty
Eureka
Kantishna
L. Minchumina
Nikolai
Alaska Range
Chugach Mts.
Yukon River
Kuskokwim R.

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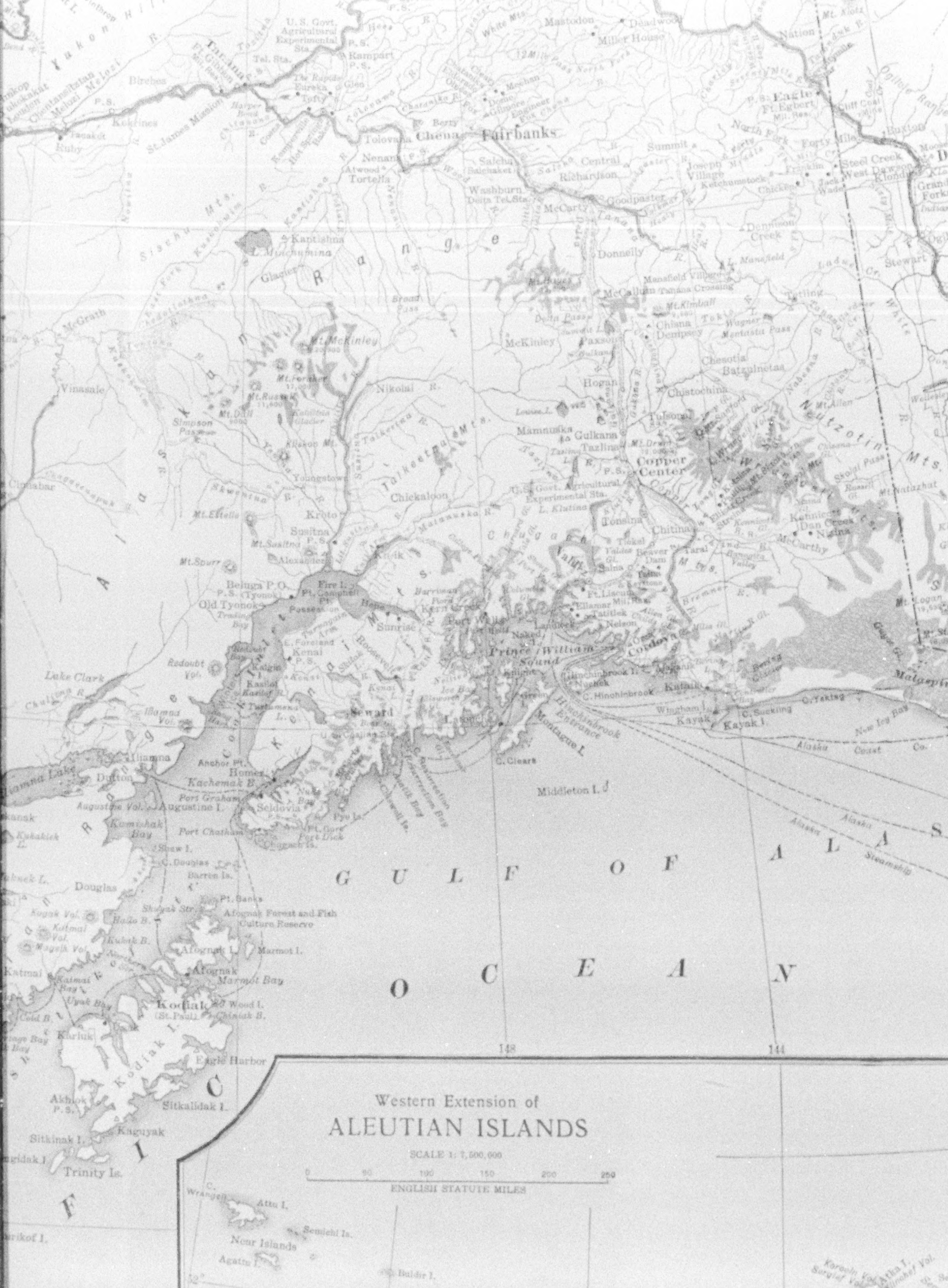
Fairbanks
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Rampart
U. S. Govt. Agricultural Experimental Sta.
Tanana
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Ruby
Kokrines
St. James Mission
Mastodon
Deadwood
Miller House
White Mts.
Eagle
Ft. Egbert
Nation
Forty Mile
Steel Creek
Chicken
Summit
Central
Richardson
Salchaket
Washburn
Nenana
Tortella
McCarty
Goodpaster
Donnelly
Kantishna
L. Minchumina
Glacier
Broad Pass
McCallum
Tanana Crossing
Mansfield Village
Chisana
Dennison Creek
Tetling
Stewart
Mt. McKinley
Mt. Foraker
Mt. Russell
Mt. Dall
Simpson Pass
McGrath
Vinasale
Cinnabar
Nikolai
McKinley
Paxson
Hogan
Chistochina
Chesotia
Batzulnetas
Gulkana
Tazlina
Copper Center
Mt. Drum
Mt. Sanford
Mt. Wrangell
Mt. Blackburn
Mt. Allen
Nutzotin Mts.
Skolai Pass
Mt. Natazhat
Mt. Logan
Matanuska
Talkeetna Mts.
Chickaloon
Youngstown
Skwentna
Mt. Estelle
Susitna
Mt. Susitna
Mt. Spurr
Alexander
Knik
Beluga P.O.
Old Tyonok
Trading Bay
Fire I.
Pt. Campbell
Possession
Hope
Sunrise
Kern Creek
Port Wells
Chugach Mts.
Valdez
Tonsina
Chitina
Tiekel
Kennicott
McCarthy
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Beaver Dam
Tasnuna
Ft. Liscum
Ellamar
Tatitlek
Landlock
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C. Hinchinbrook
Katalla
Wingham I.
Kayak
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Malaspina
Hinchinbrook Entrance
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Middleton I.
Latouche
Seward
Kenai
E. Foreland
Redoubt Vol.
Lake Clark
Iliamna Vol.
Iliamna
Iliamna Lake
Dutton
Anchor Pt.
Homer
Kachemak B.
Seldovia
Port Graham
Augustine Vol.
Augustine I.
Kamishak Bay
Port Chatham
Pt. Gore
Port Dick
Chugach Is.
Shaw I.
C. Douglas
Barren Is.
Douglas
Pt. Banks
Shuyak Str.
Afognak Forest and Fish Culture Reserve
Afognak I.
Marmot I.
Afognak
Marmot Bay
Katmai
Kodiak
(St. Paul)
Wood I.
Chiniak B.
Karluk
Kodiak I.
Uyak Bay
Eagle Harbor
Akhiok P.S.
Sitkalidak I.
Sitkinak I.
Kaguyak
Trinity Is.
Chirikof I.
Alaska Coast Co.
Alaska Steamship
GULF OF ALASKA
OCEAN
PACIFIC
148
144
Greenwich
6
Western Extension of
ALEUTIAN ISLANDS
SCALE 1: 7,500,000
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ENGLISH STATUTE MILES
C. Wrangell
Attu I.
Semichi Is.
Near Islands
Agattu I.
Buldir I.
52°
Kiska I.
U.S. Government Reservation
Semisopochnoi I.
Rat I.
Rat Islands
Amchitka I.
Gareloi I.
Tanaga I.
Kanaga I.
Adak I.
Little Tanaga I.
Great Sitkin
Korovin Bay
Atka I.
Amlia I.
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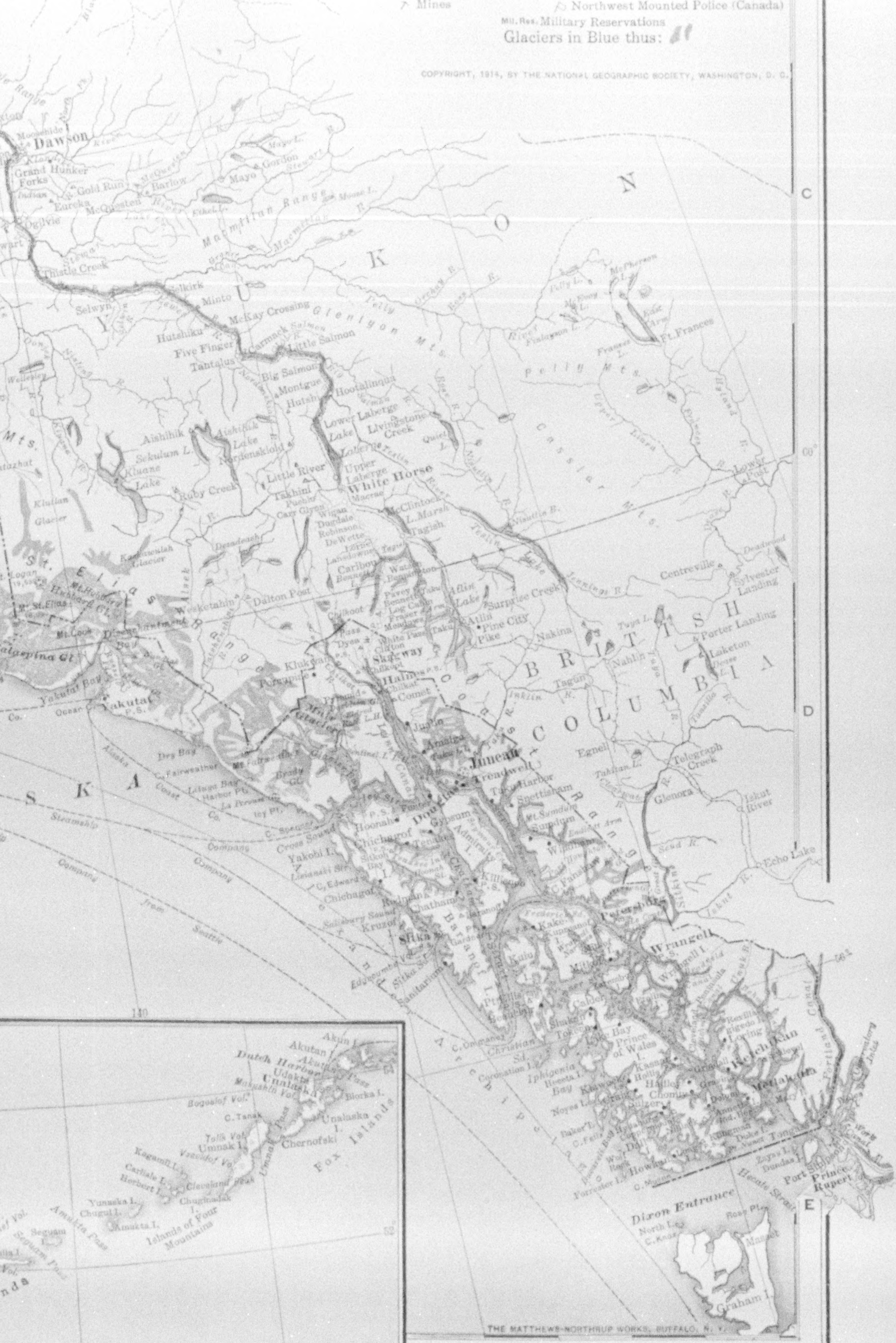
Longitude East 176° from Greenwich 180° 176° Longitude West


Mines
Northwest Mounted Police (Canada)
Mil.Res. Military Reservations
Glaciers in Blue thus:
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BRITISH COLUMBIA
A S K A
Dawson
Moosehide
Klondike
Grand Hunker
Forks
Gold Run
Eureka
McQuesten
Barlow
Mayo
Gordon
Stewart R.
Mayo L.
Ogilvie
Thistle Creek
Selkirk
Selwyn
Minto
McKay Crossing
Macmillan Range
Macmillan R.
Glenlyon Mts.
Pelly R.
Pelly Mts.
Hutshiku
Five Finger
Carmack
Little Salmon
Tantalus
Big Salmon
Montgue
Hutshi
Hootalinqua
Lower Laberge
Lake Laberge
Livingstone Creek
Aishihik
Aishihik Lake
Nordenskiold
Sekulum L.
Kluane Lake
Little River
Ruby Creek
Takhini
Upper Laberge
White Horse
Macrae
McClintock
L. Marsh
Tagish
Wigan
Dugdale
Robinson
DeWette
Carcross
Caribou
Bennett L.
Atlin Lake
Atlin
Surprise Creek
Pine City
Pike
Log Cabin
Chilkoot
Dyea
Skagway
Haines
Chilkat
Comet
Klukwan
Porcupine
Dalton Post
Wesketahin
Kluahne
Kaskawulsh Glacier
Mt. Logan
Mt. Hubbard
Hubbard Gl.
Mt. St. Elias
St. Elias Range
Mt. Cook
Disenchantment Bay
Malaspina Gl.
Yakutat Bay
Yakutat
Ocean
Dry Bay
Fairweather
Mt. Fairweather
Lituya Bay
Harbor Pt.
La Perouse Gl.
Icy Pt.
Brady Gl.
Glacier Bay
Muir Glacier
Juneau
Amalga
Treadwell
Douglas
Taku Harbor
Snettisham
Mt. Sumdum
Sumdum
Windham
Cross Sound
Hoonah
Chichagof
Gypsum
Tenakee
Admiralty I.
Yakobi I.
Chichagof I.
Killisnoo
C. Edward
Salisbury Sound
Kruzof
Sitka
Chatham
Baranof I.
Kake
Kupreanof I.
Petersburg
Wrangell
Wrangell I.
Tokeen
Prince of Wales I.
Kasaan
Ketchikan
Metlakatla
Loring
Revillagigedo I.
Iphigenia Bay
Noyes I.
Klawock
Craig
Hollis
Howkan
Dall I.
Forrester I.
Dixon Entrance
North I.
C. Knox
Rose Pt.
Masset
Graham I.
Port Simpson
Prince Rupert
Portland Canal
Hecate Strait
Dundas I.
Zayas I.
Alaska Coast Co.
Steamship Company from Seattle
Christian Sd.
Coronation I.
Edgecumbe
Sitka Sd.
Sanitarium
C. Ommaney
Telegraph Creek
Glenora
Iskut River
Echo Lake
Egnell
Tahltan L.
Nahlin
Nakina
Tagish
Teslin Lake
Teslin R.
Cassiar Mts.
Centreville
Sylvester Landing
Porter Landing
Laketon
Dease L.
Lower Post
Liard R.
Frances L.
Ft. Frances
Finlayson L.
McPherson L.
Pelly L.
Hyland R.
Deadwood
Akun I.
Akutan I.
Akutan
Dutch Harbor
Unalaska
Udakta
Makushin Vol.
Bogoslof Vol.
Biorka I.
C. Tanak
Unalaska I.
Chernofski
Fox Islands
Umnak I.
Umnak Pass
Tulik Vol.
Vsevidof Vol.
Kagamil I.
Carlisle I.
Herbert I.
Cleveland Peak
Chuginadak
Yunaska I.
Chugul I.
Amukta I.
Islands of Four Mountains
Amukta Pass
Seguam
Seguam Pass
52°
West 172° from Greenwich 168°
140
136°
132°
60°
56°
11
THE MATTHEWS-NORTHRUP WORKS, BUFFALO, N. Y.

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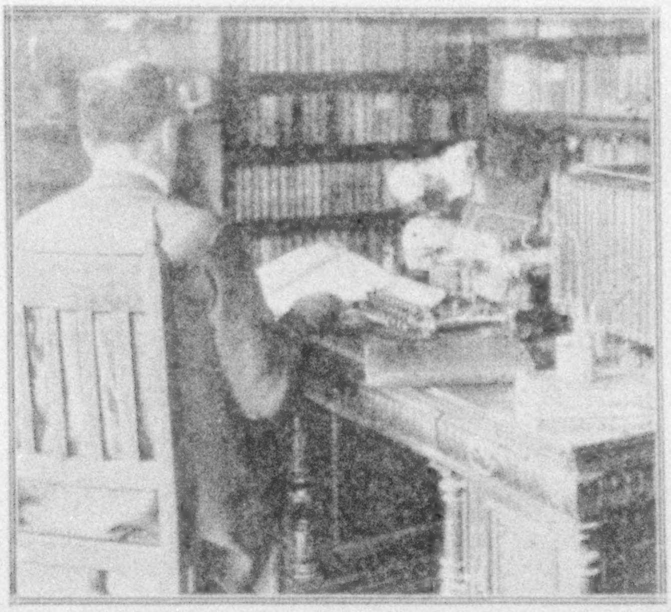
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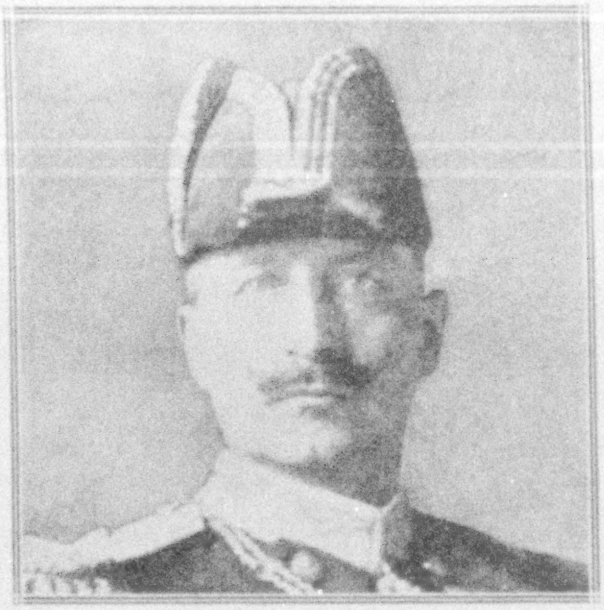
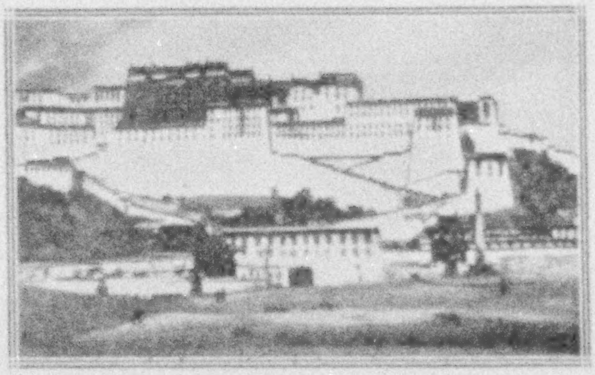
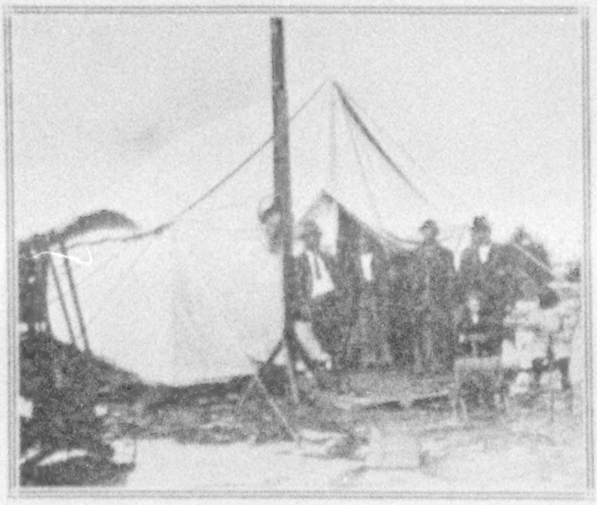


Photo, Bieber
EMPEROR WILLIAM II. OF GERMANY

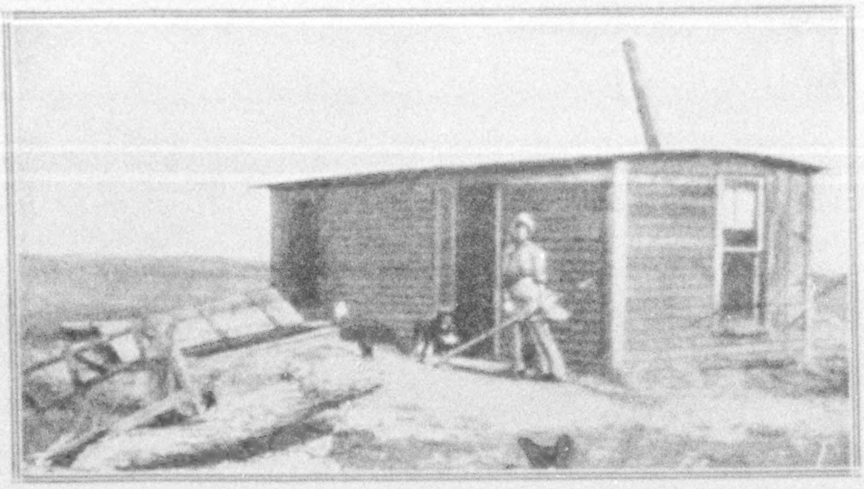


Photo, W. S. Campbell
THE POTALA, LHASSA
Home of the Dalai Lama of Tibet

CHARLES S. WHITMAN, ESQ.
District Attorney, New York County, at his desk in his office
Subscriber, No. 24,421



The ever-shifting camp of MR. E. A. BAUGHAN, a construction engineer in Georgia



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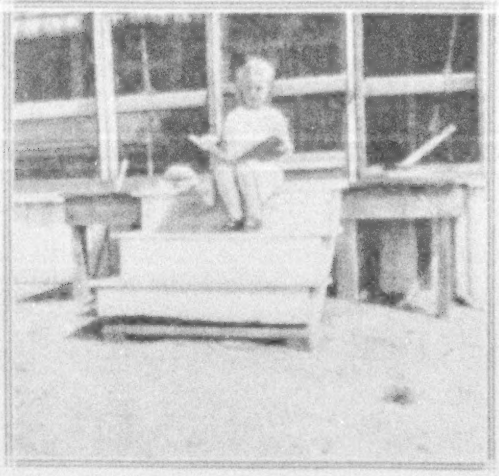
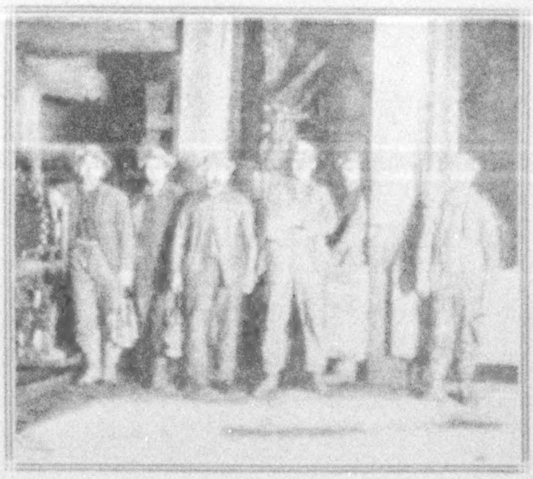
Subscriber, No. 35,724



DAUGHTER OF A. E. McGILL
United Gold Mines, Congress, Ariz.



A. E. ALLADADO
Standing on the right of group of his fellow miners in the Homestake Mine, South Dakota

Owners in Many Lands

(2) **It is the most complete work of reference** that the world has ever seen. The index of 500,000 entries enables the reader to secure instantly an answer to any specific question. The 569 maps are also indexed, there being no less than 125,000 gazetteer entries.

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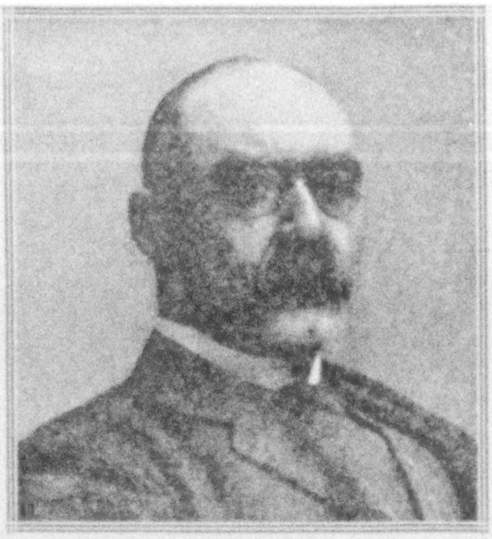
THEODORE ROOSEVELT
Ex-President of the United States, at his editorial desk in the office of The Outlook, New York

SACHI PRASANNA MUKHERJEE
Bengalee Zemindar, Calcutta. Two volumes of the Britannica are on the table

Photo, Beach
HIS EMINENCE CARDINAL BOURNE
Roman Catholic Archbishop of Westminster



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RUDYARD KIPLING
Novelist and Poet
Subscriber in England, No. 2012

VILHJALMUR STEFANSSON
Leader of the Canadian Arctic Expedition, who took a set of the Encyclopædia Britannica, the only work of reference in his equipment

Photo, Langfier

GUGLIELMO MARCONI
Inventor of the Marconi system of wireless telegraphy
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A Few of the 50,000 Owners (continued)

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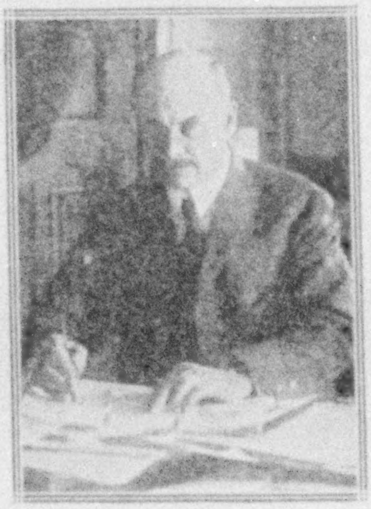

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The Manager, Encyclopaedia Britannica

JOSEPH A. ARMSTRONG
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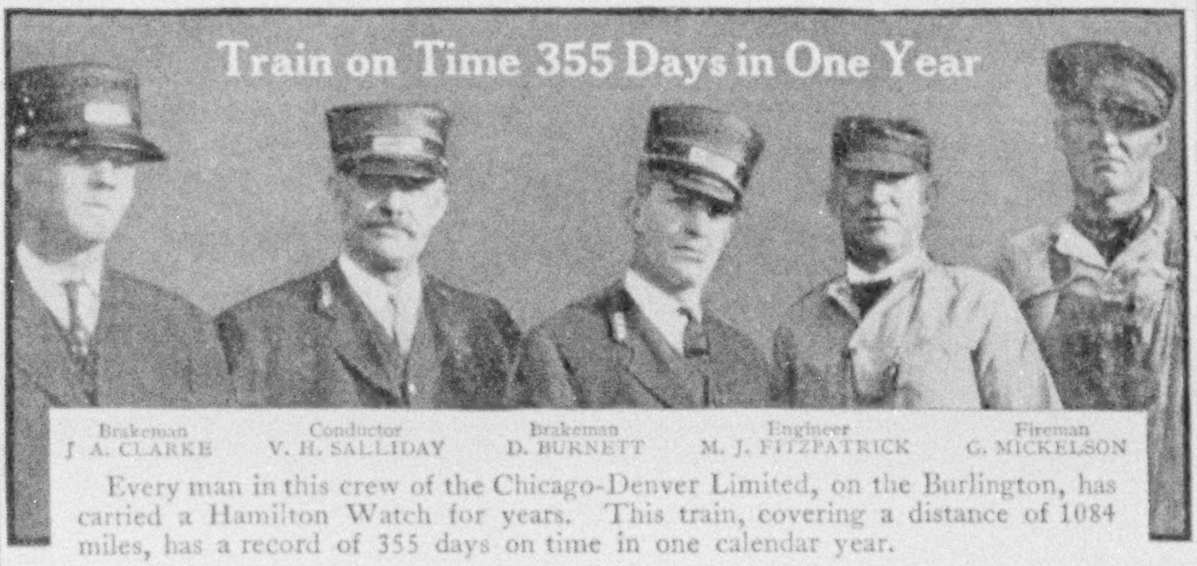
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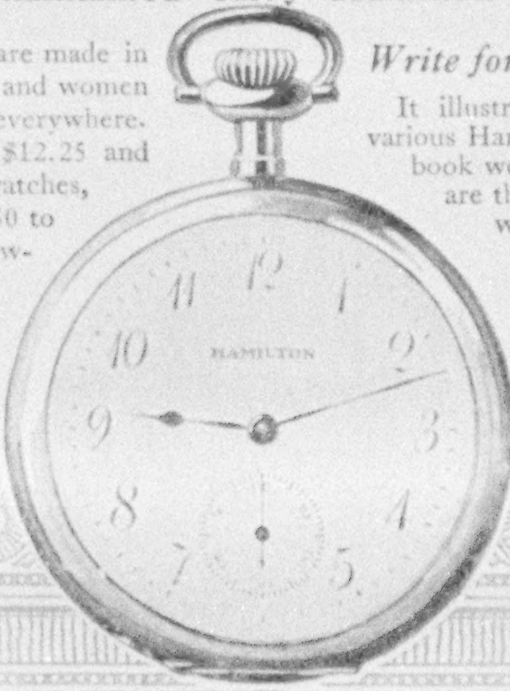

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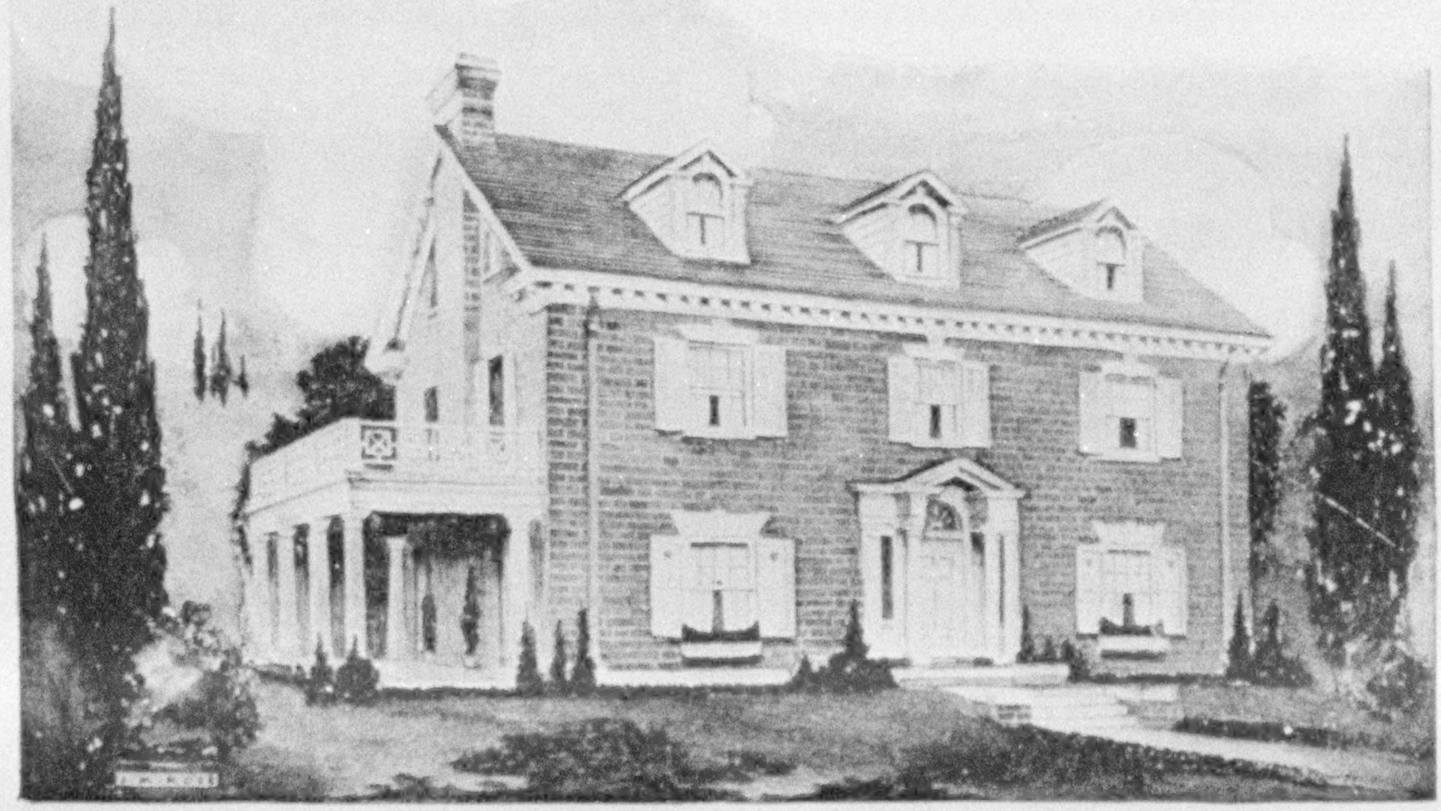

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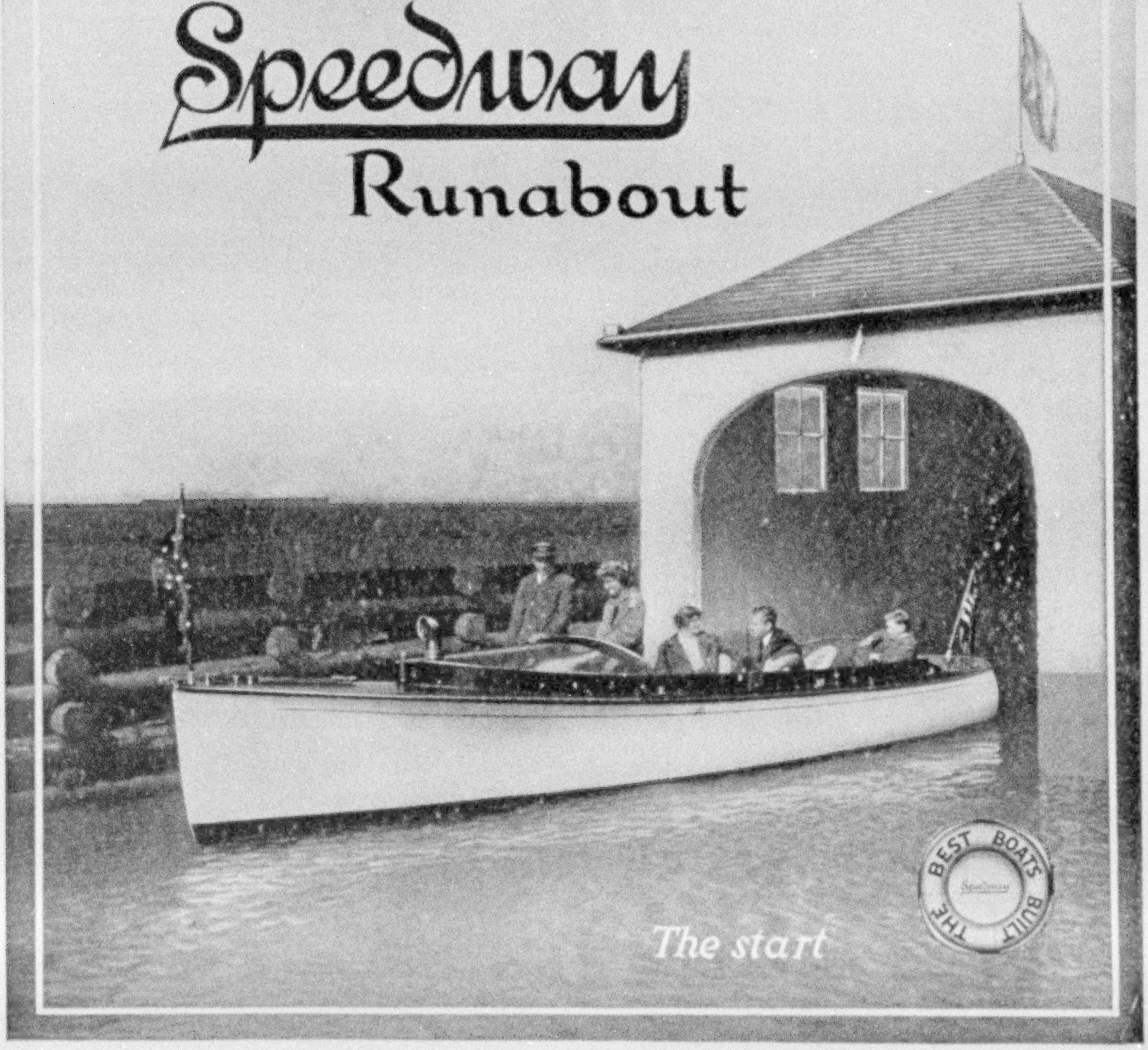

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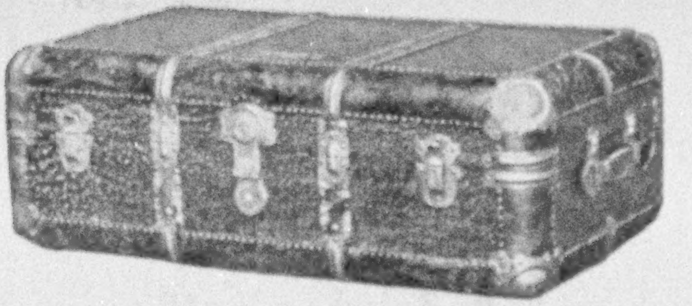

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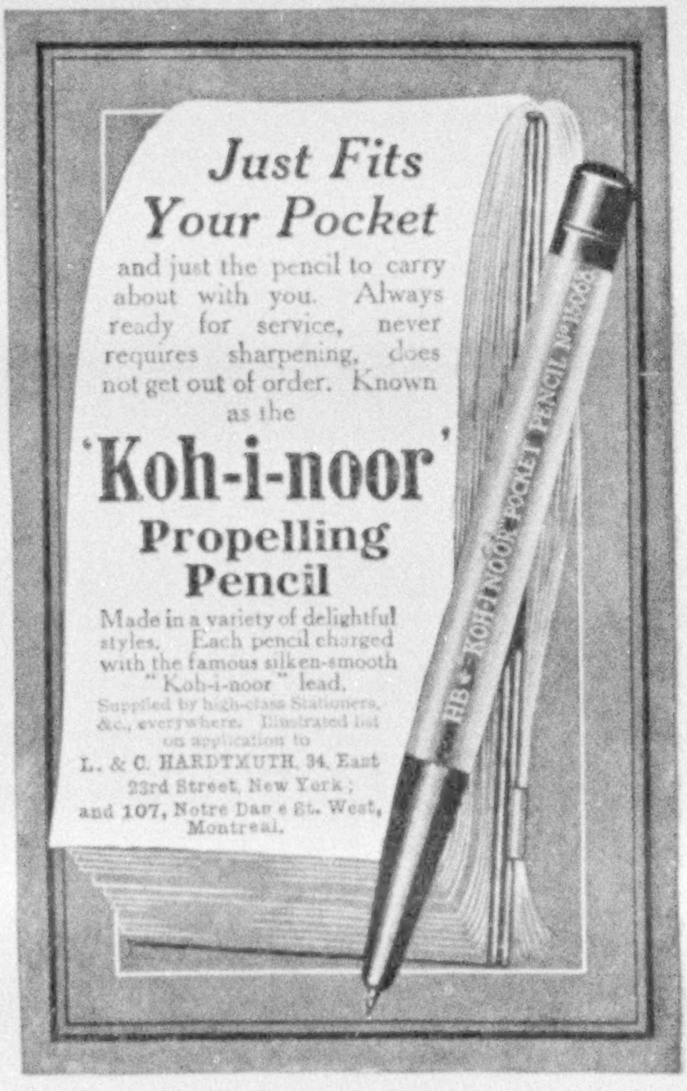

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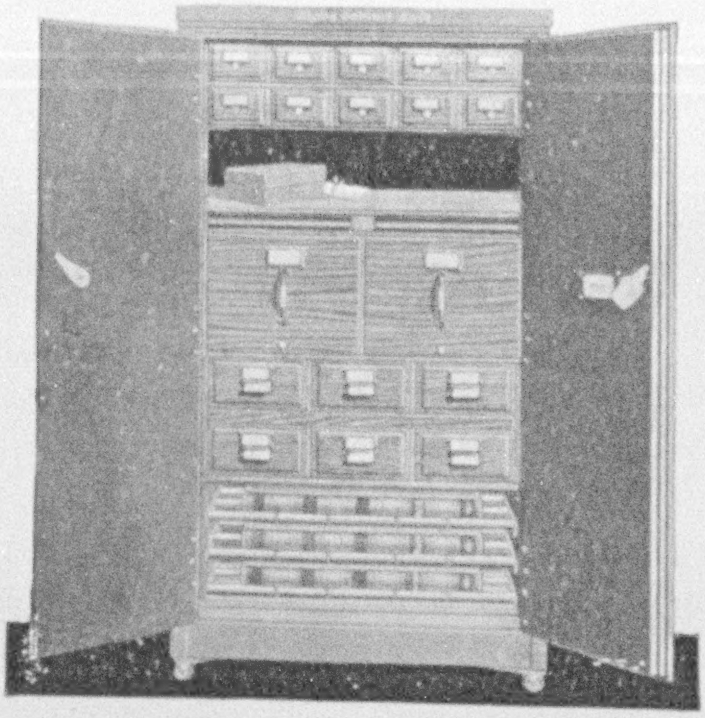

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Vol. XXV, No. 2 WASHINGTON February, 1914

THE NATIONAL GEOGRAPHIC MAGAZINE

BATTLING WITH THE PANAMA SLIDES

By William Joseph Showalter

Author of "The Panama Canal" and "The Countries of the Caribbean," in the National Geographic Magazine

THE only reason why ships have not been using the Panama Canal since last October is that Nature has been battling to the last ditch in her efforts to thwart the purpose of man to put a shipway through the vitals of proud old Culebra Mountain. But for this great battle, Culebra Cut would have been a finished job two years ago.

The weapons used by Nature in her efforts to confound the plans of the canal engineers have been slides and breaks in the banks of the canal, and effective weapons indeed have they proven. How, with them, she has stood between the canal army and the completion of the task to which it addressed itself constitutes the most thrilling episode in the history of canal engineering.

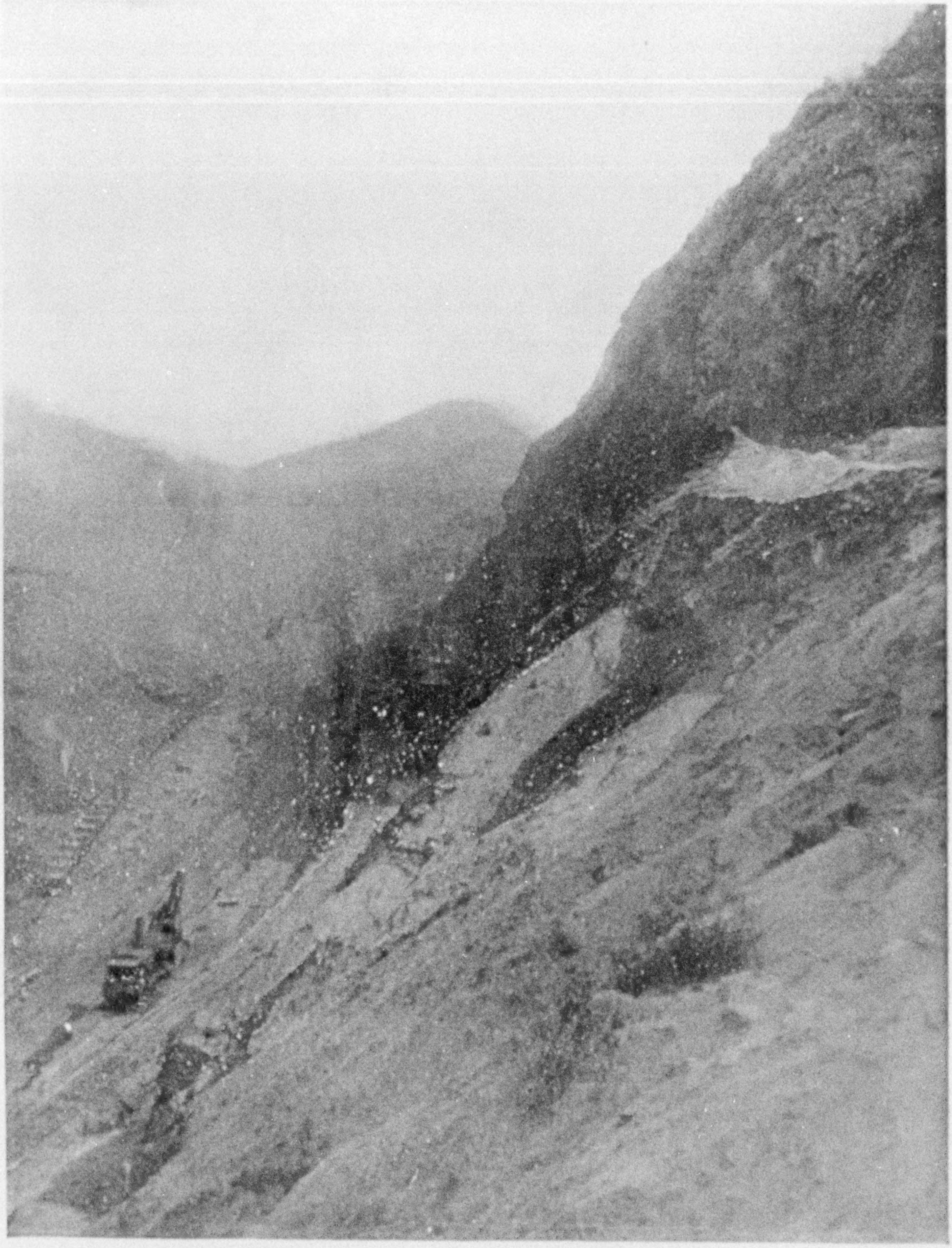
Over 250 acres of ground lying outside of the intended banks of the canal, and containing over 30 million cubic yards of material, have swept, with silent but terrific force, down into the canal. Now this onslaught has demoralized an entire railroad system; now it has put the compressed air and water systems out of commission; now it has bottled up one end of Culebra Cut with an avalanche of debris; now it has imprisoned dirt trains and wrecked steam shovels. But with all the wreck and ruin and chaos there have been men with wills of iron who have met each new situation with a new spirit of determination; men who have never permitted any catastrophe to turn them aside from their ultimate purpose; men whose achievements in the face of unprecedented difficulties make a story as inspiring as anything in human history.

No one who failed to visit the Isthmus during the construction period can understand the full import of the coming of these slides into Culebra Cut. With each passing year they have renewed and redoubled their attacks on the canal plans. They seem to be maneuvered by the hand of some great marshal and sent forth to the fray in every way calculated to put the canal engineers to discomfiture.

Now they are quiescent, attempting to lull the engineers into a false security; now they make a feint, stopping short of an actual conflict; now they come in the dead of night, spreading chaos and disrupting everything in whatever direction they move; now they set up the appearance of being rendered thoroughly harmless by allowing dikes of basalt to peep out which seem to tie them to the bowels of the earth, only to destroy the hopes which these dikes arouse in the hearts of the besiegers, by shearing them off as if they were but pipe-stems, and then flowing, unrestrained, into the cut.

Consider what the removal of 30 million cubic yards of material means. It is enough to build a sort of Chinese wall 7 feet thick and 7 feet high reaching from New York to San Francisco. It is

XUM



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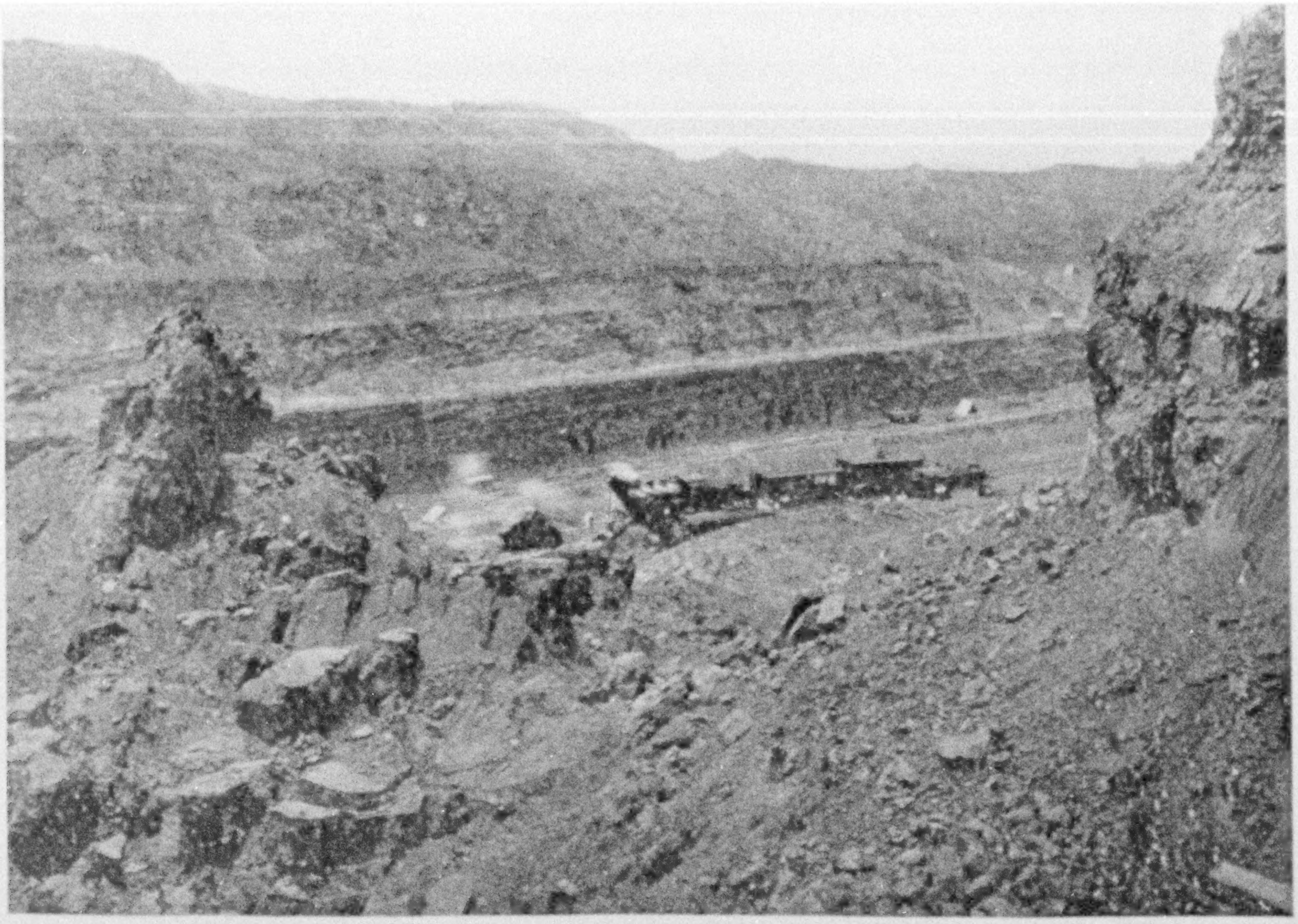
THE DEEPEST PART OF CULEBRA CUT

Looking south from the west bank of the canal, near Contractor's Hill, Cucaracha slide shows on the left side of the picture. Some 19 million pounds of dynamite have been exploded in Culebra and enough material removed to make 26 pyramids, each as large as the Great Pyramid of Cheops, in Egypt, or 2,500 shafts, each as large as the Washington Monument.



LOOKING INTO THE CULEBRA CUT FROM THE TOP OF A SLIDE, SHOWING THE BROKEN BANK

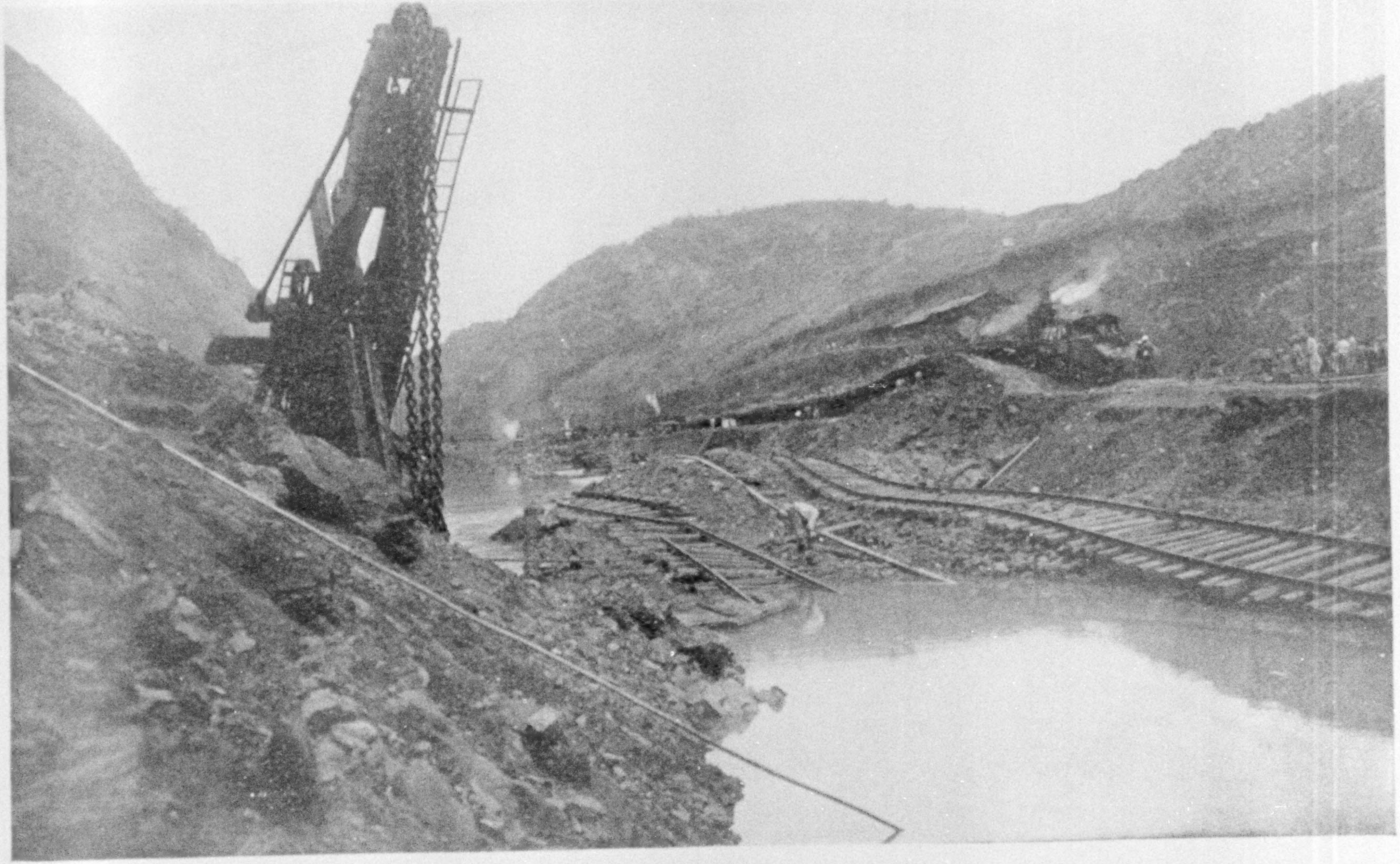
more than could be drawn by all the horses and mules in the United States. It would fill a million and a half big Lidgerwood cars, enough to make a string 12,000 miles long. These figures show that the mere getting rid of this surplus material is no mean job.

But when you reflect that each yard of this sliding material has rendered doubly difficult the getting out of three yards of other material, the true meaning of the slides will begin to appear. There have been times when 170 trains were going out of the cut one day at the south end, only to be stopped entirely the next day by the Cucaracha slide getting busy. Now there may be a dozen tracks in use in the cut, and 24 hours later half of these will be out of commission. That is what makes the slides such serious things to combat.

THE GREATEST ENGINEERING WONDER OF THE AGE

It is no wonder that the lamented Colonel Gaillard lost his health and his life fighting them. It is no wonder that Colonel Goethals has aged 20 years in six while struggling with them. But it is a wonder, the greatest engineering wonder of the age, that in spite of these difficulties they have been able to remove 106 million cubic yards of material from the cut in less time than it was estimated that they could remove 53 million cubic yards. And this wonder grows when I look at their cost sheets and see them removing a cubic yard for an average of 60-odd cents, when it was estimated that, unhindered by slides, the cost of removing a cubic yard would be 98 cents.

Speaking of the terrific strain involved upon those who are responsible for the battle with the slides at Panama, no incident in my life can stand out more vividly than one I will now relate, illustrating the meaning of it all to the engineers. Cucaracha slide resumed her old tricks when I was on the Isthmus last May. She had been quiescent for some time, and it was believed that she had retired from the fray for good and all.



THE RAILROAD DESTROYED BY A SLIDE

Colonel Gaillard, who had charge of the work in Culebra Cut, never knew, when he returned to work in the morning, that tracks and shovels would be found as left the night before

Culebra Cut began to look like a finished job, with only a little hump in the middle mile to be taken off. Then one night, while the canal army was asleep, she poured down into the south end of the cut an avalanche of material that filled it up to the 67-foot level, bottled up the railroad exits from that end, and did sundry other evil things to the plans of the engineers (see page 146).

When I heard about it I went up to Culebra to talk with Colonel Goethals as to its bearing on the immediate future. After passing the time of day I asked him how he was, to which he replied:

"Well, about the best way I can express it is to say that I am 'home-sick.' Cucaracha looks bad, but she is not by any means the greatest of my woes. I trampled over her this morning, and the basalt dikes that are peeping out seem to indicate that she will be 'dead' before very long. But over here on this side of the cut," pointing out the window of his office as he spoke, "there is beginning to show an indication of a new break, and if the actualities prove as bad as the indications suggest, it will outdo anything we have had to contend with yet."

And as he spoke I saw the tears well up in the eyes of that man of iron, and I understood what those slides were costing him. I knew then whence had gone that buoyancy of youth which I had met in 1908 and that enthusiasm of purpose which I had seen in 1910. Now instead there was the grim determination of a veteran of a thousand conflicts, who would fight on to the end only because Duty's voice ever spoke louder in his ear than Pleasure's.

NO ONE COULD FORETELL THE SLIDES

The determined character of the slides that beset the canal engineers is strikingly shown by the amount of their material that had to be removed in comparison with the total excavations for each year. Prior to 1910 they presented no serious obstacle, since the canal was not deep enough to create the unbalanced condition necessary for their development. Up to that year the excavations on account of slides were only 7.87 per cent of the total excavations.

During 1910, however, they became more active, and seven weeks out of the 52 would have been required to take care of the 14.83 per cent of all excavations which represented the slide debris taken out. In 1911 there was a still greater activity in slides, and, omitting the extra difficulties they imposed, it required 13 weeks to take out the material they brought into the cut, this material amounting to 26.30 per cent of the total excavations for the year.

The succeeding year saw the cut going still deeper and the slides growing larger and still more bothersome, so that 34.5 per cent of the excavations of that year were of slide material, whose removal required 18 weeks.

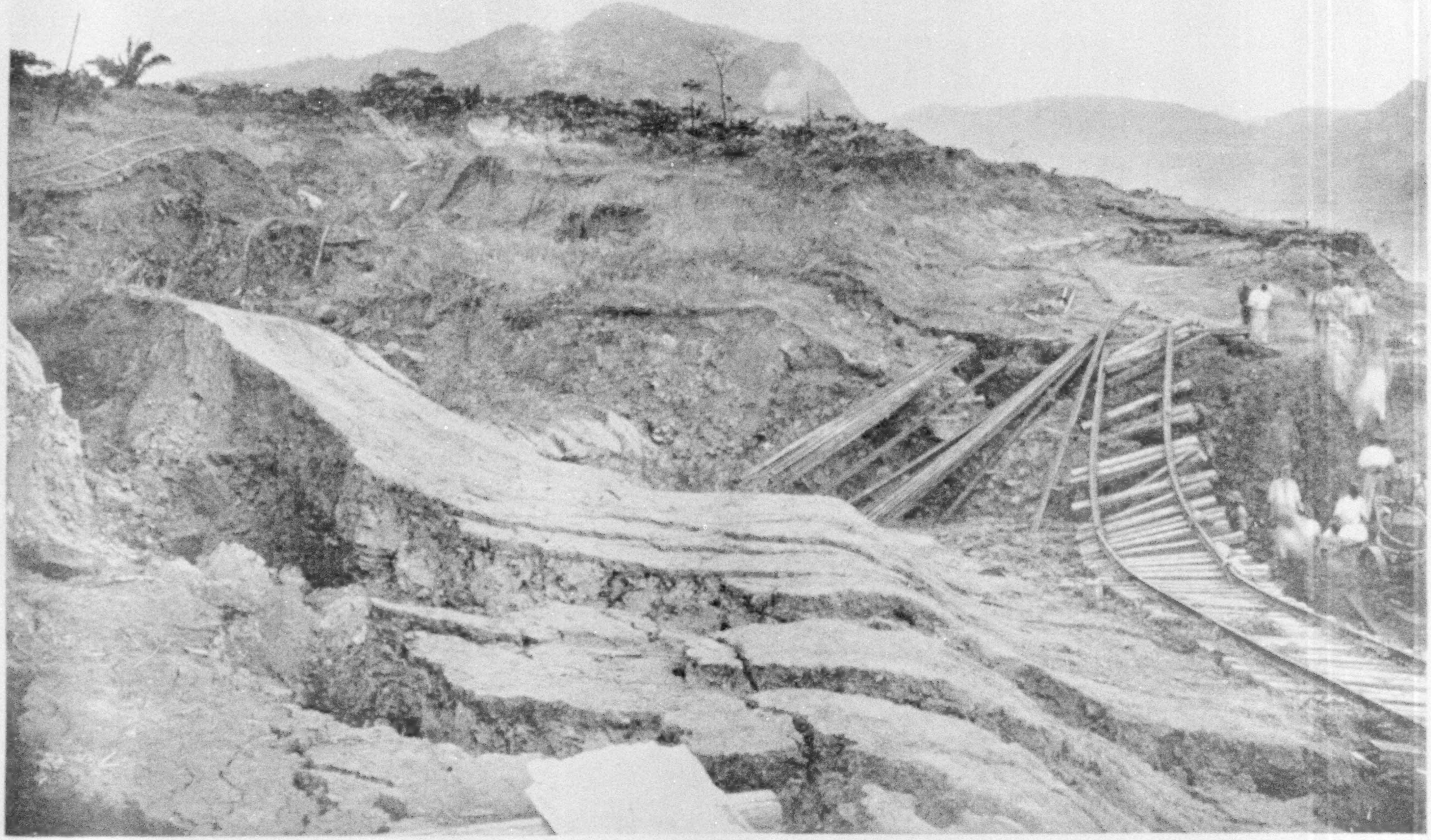
During the year 1913 the cut approached final grade and the slides set a new record, requiring 46 per cent of the total excavations for the year, which accounts for 24 weeks' work.

The present year, beginning July 1, 1913, saw only two months required for the final bottom to be reached in the cut, outside of the material brought in by the slides, so that at least 44 weeks of this year are chargeable against the slides.

SLIDES HAVE DELAYED THE COMPLETION OF THE CUT BY 22 MONTHS

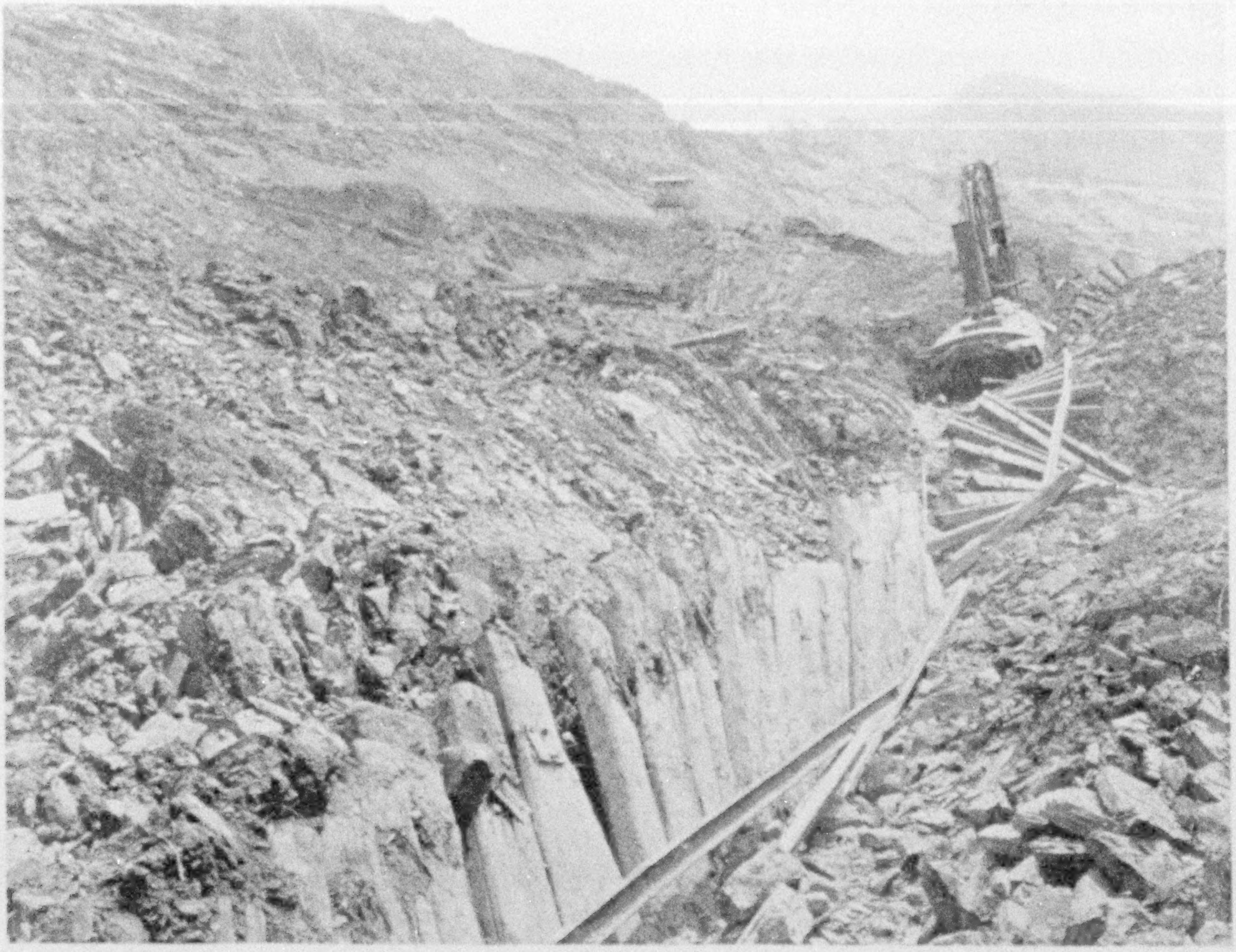
From all this it must appear that the bare work of removing the material from the cut brought into it by the slides, leaving entirely out of the reckoning the immense handicap in the prosecution of the regular work that they involved, held back the completion of the cut by 22 months at least.

It is certainly reasonable to suppose that all the delays the slides imposed held up the work by eight months, so that but for them we might have seen a cut through Culebra Mountain, with a bottom width of 300 feet, completed by January 1, 1912, in five years; whereas the most conservative estimate had set down eight and a half years to make a cut with a bottom width of 200 feet. As a matter of fact, the amount of material that was contained in the cut as originally planned, 53,800,000 cubic yards, was removed before the end of the calendar year 1910, or in less than four



BREAKS IN THE CANAL BANK DESTROY THE TRACKS

One type of slide was caused by cracks occurring in the banks of the canal, and often these were 300 or 400 feet back from the edge of the cut. The ground would settle, and after a time the whole mass would slide gracefully into the canal, wrecking the railroad tracks and engulfing steam shovels.



A STEAM SHOVEL HALF BURIED BY A SLIDE

Many miles of railroad track and steam shovels by the dozen have been destroyed by slides in the cut. Often, however, the slide has bodily raised the bottom of the cut, leaving steam shovels standing on their tracks, hardly out of alignment, but 15 feet or more above the place where they should normally be.

years of actual work and at a total cost of about 50 million dollars.

One of the wonderful things about the building of the canal was how, in the face of all the unforeseen difficulties that the slide problem involved, Colonel Goethals and Colonel Gaillard were able to drive down unit cost as the mercury in the difficulty thermometer sped upward. In 1908 it was estimated that the cost of removing a yard of spoil would be around 98 cents for the whole cut.

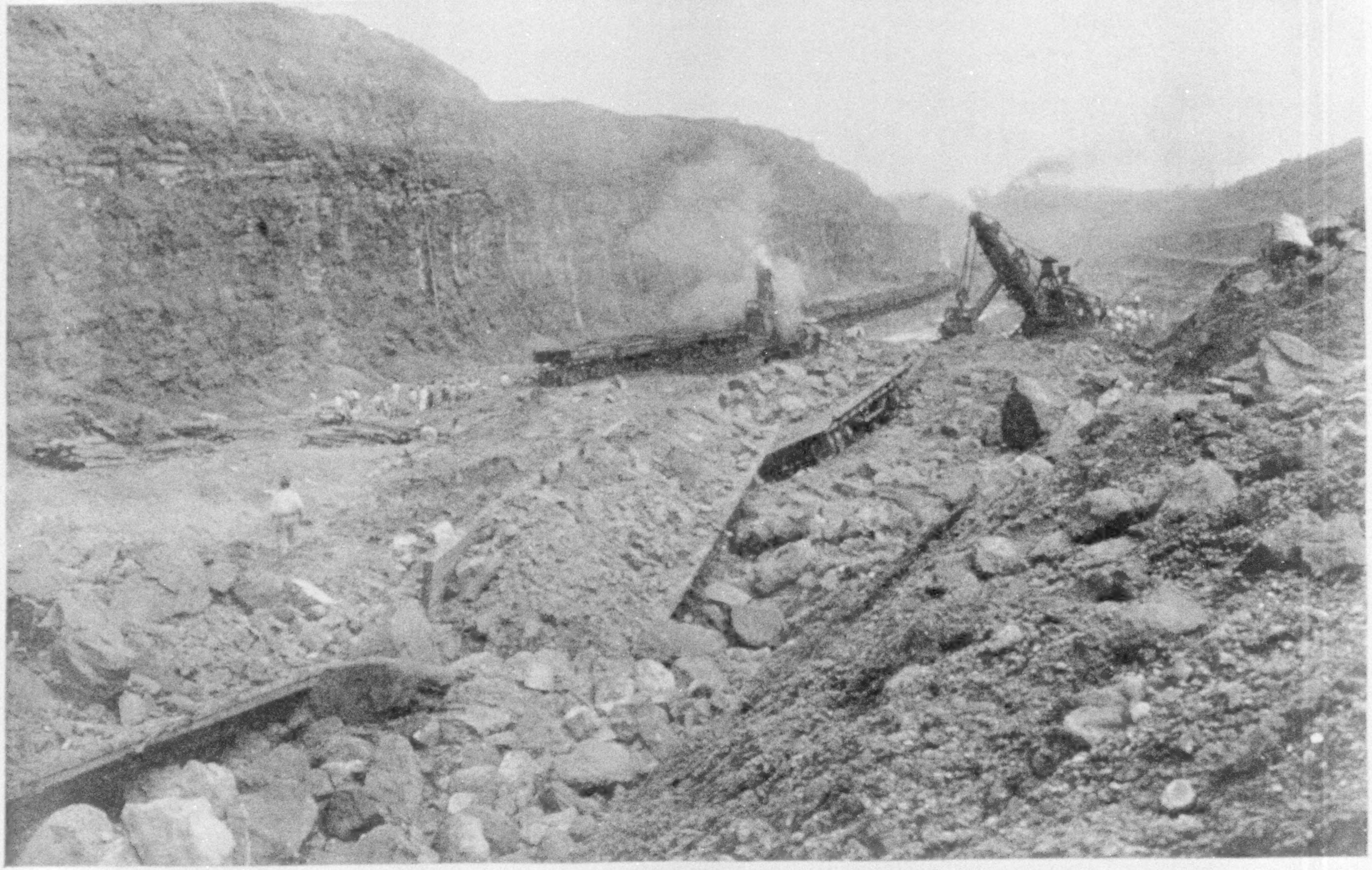
For the fiscal year 1909 they hammered this cost down to 78⅔ cents; the next year they lowered it to 73⅝ cents; in 1911, although the slide problem became much more acute, they forced it still lower—to 63⅜ cents.

But they were not satisfied even then; 1912 saw the slides more troublesome than ever, and in spite of this they forced the unit cost down to 54⅜ cents. Than this, there is no prouder showing in the history of business economy or of engineering.

Even in 1913, with the slides requiring nearly half of all the work and imposing unprecedented difficulties upon the engineers, they managed to hold down the yardage cost to 59 cents. And that is why they were able to save 20 cents on every one of the 107 million cubic yards taken out of the Central Division up to July 1, 1913—enough in the aggregate to finance the removal of all the slides, with a handsome little nest-egg left over.

DIFFERENT VARIETIES OF SLIDES

The slides with which the canal engineers have had to deal in solving the problems of Culebra Cut are of four classes. The most troublesome of these



A BREAK IN THE CANAL BANK AT CULEBRA, SHOWING LOADED FLAT CARS CAUGHT IN THE SLIDE

"Over 250 acres of ground lying outside of the intended banks of the canal, and containing over 30 million cubic yards of material, have swept, with silent but terrific force, down into the canal. Now this onslaught has demoralized an entire railroad system; now it has put the compressed air and water systems out of commission; . . . now it has imprisoned dirt trains and wrecked steam shovels" (see text, page 133).

are, more properly speaking, structural breaks.

As the big ditch neared final grade the depth was so great that the downward pressure from the top of the embankment forced the weak rock at the bottom to crumble, and this led to great fissures in the ground back some distance from the edge of the embankment. These would gradually widen, and the material would sweep downward and outward and upward into the bottom of the canal, often raising the bottom 10 to 20 feet higher than it was a few hours before.

The great slide on the west bank at Culebra, covering some 75 acres of ground and involving millions of cubic yards of material, is the best example of this kind of slide. Nearly half of all the sliding material on the canal strip was embraced in this great movement.

It began in 1907, and during the more than six years of its activity it required the dismantling and removal of half of the village of Culebra to keep out of its way. Now it was the American living quarters that had to go; now it was the big Y. M. C. A. club house, after being shored up repeatedly in the hope of saving it; now it was the penitentiary, and so on. If the cut had gone much deeper it might have been the very Administration Building itself that would have been next to go.

THE FAMOUS CUCARACHA SLIDE

The other principal type of slide is represented by Cucaracha, a mass of soft earth with no rock reaching down deep enough or holding strong enough to keep it from sliding in, slipping across a smooth surface beneath it.

Cucaracha scared out the French. It is said that when they were working along at her toe and she began to give them a tropical imitation of a glacier sliding down into a stream, they saw their visions of a sea-level canal disappearing into the realms of impossibility. At any rate, they promptly quit excavating at the bottom of Cucaracha and left her as a problem for the Americans; and a problem she declared herself to them back as far as 1905.

Cucaracha has been like the poor—a problem always with the canal engineers. Every time they got a little nearer toward the final bottom of the cut, Cucaracha would take a fresh slide, sometimes shooting millions of yards of material down the embankment and across the cut with such force that her toe would turn to the opposite bank, some 60 feet or more (see page 146). She kept this up in season and out, bottling up the south end of the cut, and so preventing the work from going forward that Colonel Goethals finally determined to let the water in and to dredge her out. He is now inviting her to do her very worst. He has a dredging fleet ready to take her out as fast as she comes in, and it now looks as if she has slid until she can slide no more (see page 148).

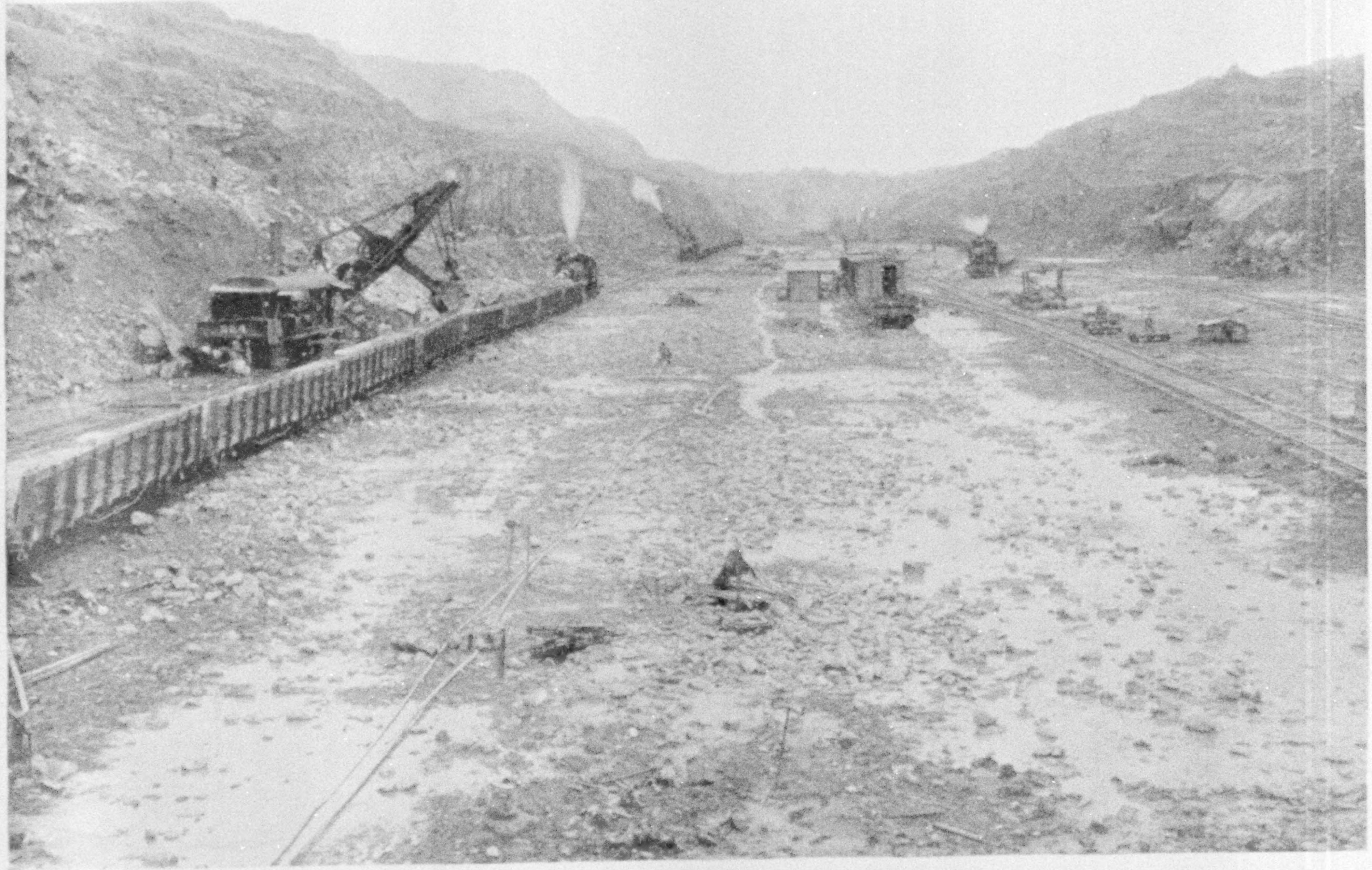
Meanwhile Colonel Goethals, in keeping with a suggestion made by Division Engineer Cole, decided to attack Cucaracha in the rear. She had slid and kept a-sliding until she went away back past the summit of the hill, and so it was decided to sluice off all the material that would drain away from the canal.

The plan worked well, and Cucaracha, in her final struggle against the engineers, finds herself beset before and behind, and soon she will become a thing of the past forever. But during her unremitting fight she has shut up Culebra Cut dozens of times, has brought 50 acres of ground, scenery and all, into the cut, and has required the removal of some eight or nine million cubic yards of material.

Fortunately the two great hills, Gold Hill and Contractor's Hill, stand like Gibraltars, and rear their heads proudly above the majestic scene below. They seem to be of solid rock wherever there might be danger of slides if they were not. Gold Hill is flanked by Cucaracha on the south and by East Culebra slide on the north, but has never given any sign of wanting to join the flowing procession into the cut. It rises 652 feet above the sea and is the highest hill in the canal region.

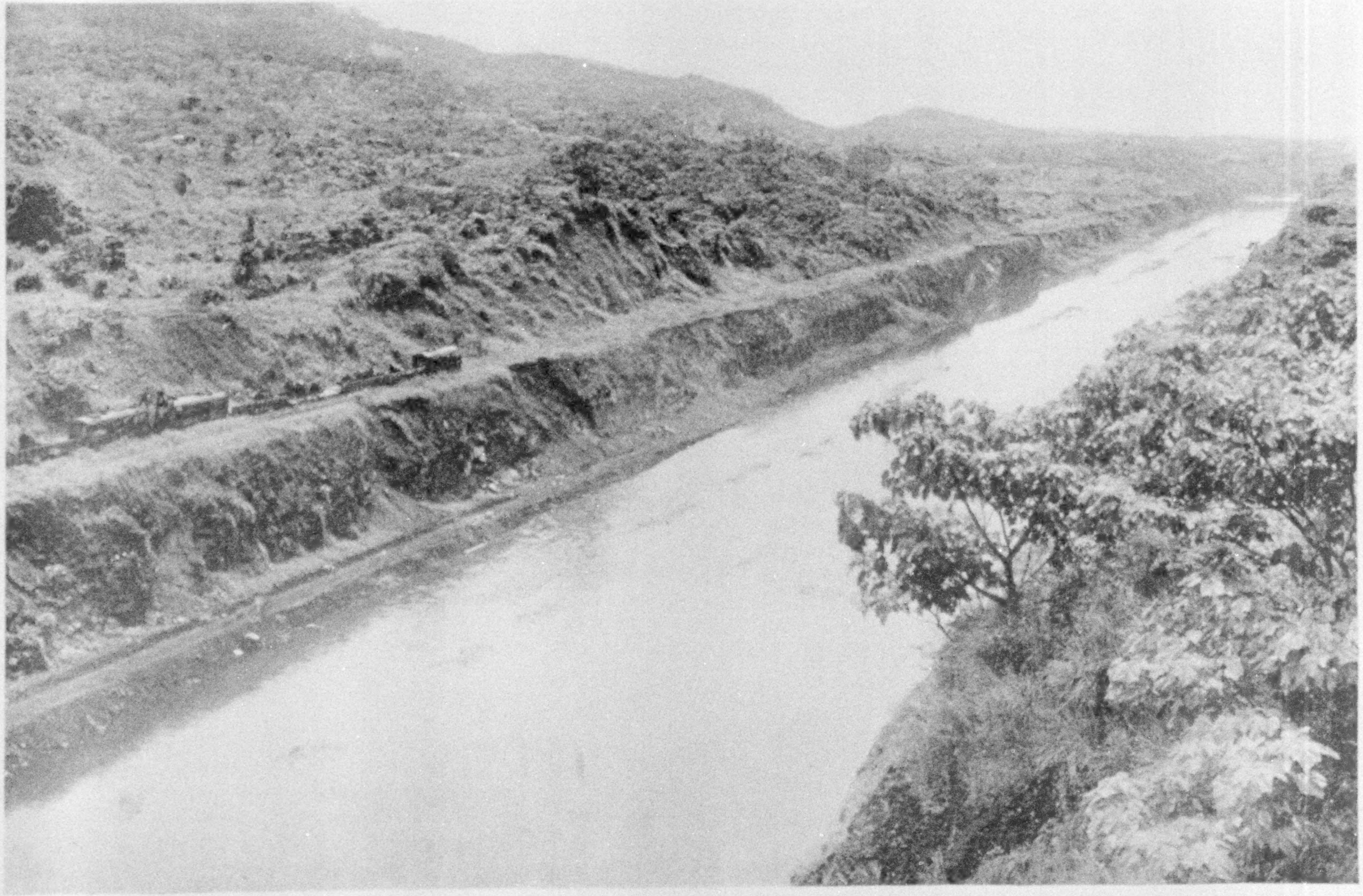
HOW THE MOUNTAIN CAME TO MOHAMMED

The slides have played many fantastic tricks in the course of the construction



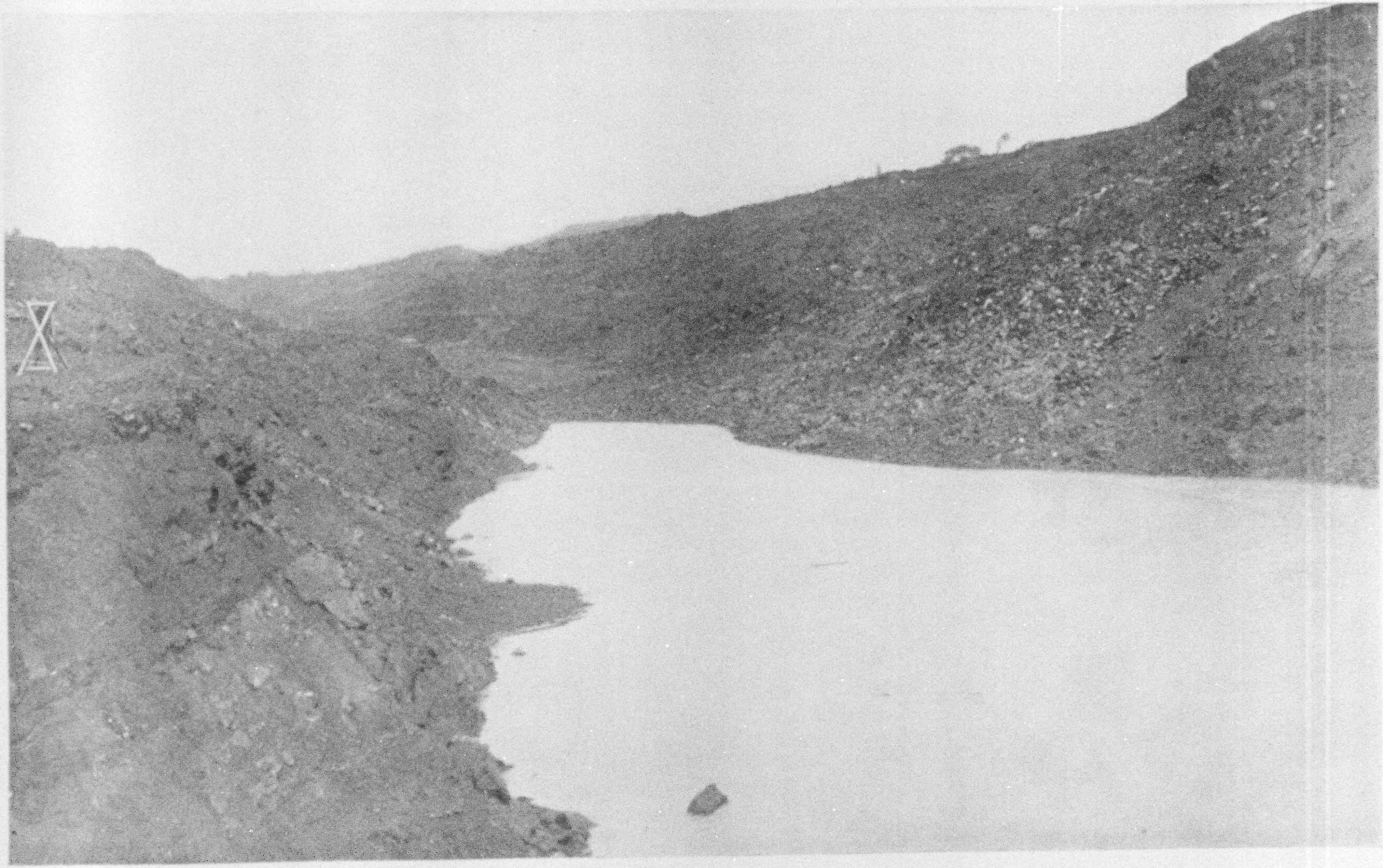
A VIEW ALONG THE BOTTOM IN THE CULEBRA CUT

Where the cut was not impeded by the slides it looked just like this picture. When the water was let in about nine-tenths of the cut was in this condition



THE CUT AT BAS OBISPO, SHOWING DEEPEST PART OF THE EXCAVATION

The intention of the canal engineers is to cover the banks of the canal through Culebra Cut with vegetation, in order to prevent those small slides that come down through erosion. When the ships of the future use the canal they will sail between banks of tropic green



SLIDES FROM BOTH BANKS BLOCK THE CANAL: SEPTEMBER 20, 1913

"The slides seem to be maneuvered by the hand of some great marshal and sent forth to prey in every way calculated to put the canal engineers to discomfiture; now they are quiescent, attempting to lull the engineers into a false security; . . . now they come in the dead of night, spreading chaos and disrupting everything in whatever direction they move" (see text, page 133).

of the canal. At one time Cucaracha picked up a steam shovel, track and all, and moved it 50 feet away, but still standing ready for operation as though nothing had happened, except that it was cut off from the dirt-train tracks. At another place and time Mohammed did not have to go to the mountain, for it came to him; so at Panama a shovel was able to make a hundred trips or more back and forth along the base of a slide without moving a step closer to the dirt, for the slide came down just as fast as the shovel worked.

During their history the Culebra Cut slides destroyed over 200 miles of railroad track. Sometimes a slide would come down, forcing one track out of position, passing under the next one without disturbing it at all, and then upheaving the material under the third track mayhap as much as 10 or 20 feet.

All manner of efforts were put forth to prevent slides. It was once proposed that cutting off the top of the bank above the cut would prevent those that developed through structural breaks. But this work was vigorously prosecuted for awhile with no important bearing on the ultimate result. At another time it was suggested that a revetment of concrete along the banks of the cut would protect it, but this was a failure also. The water that seeped down from the surface got in behind the concrete and caused it to loosen its hold and scale off.

At another time it was suggested that letting water into the cut would tend to develop an equilibrium and thus prevent additional slides. But this method of treatment succeeded no better than those methods which were tried out before; and so the settled policy became one of inviting all slides that intended to come down to do so quickly, so as to have it all over with.

WHAT CAUSES THE SLIDES

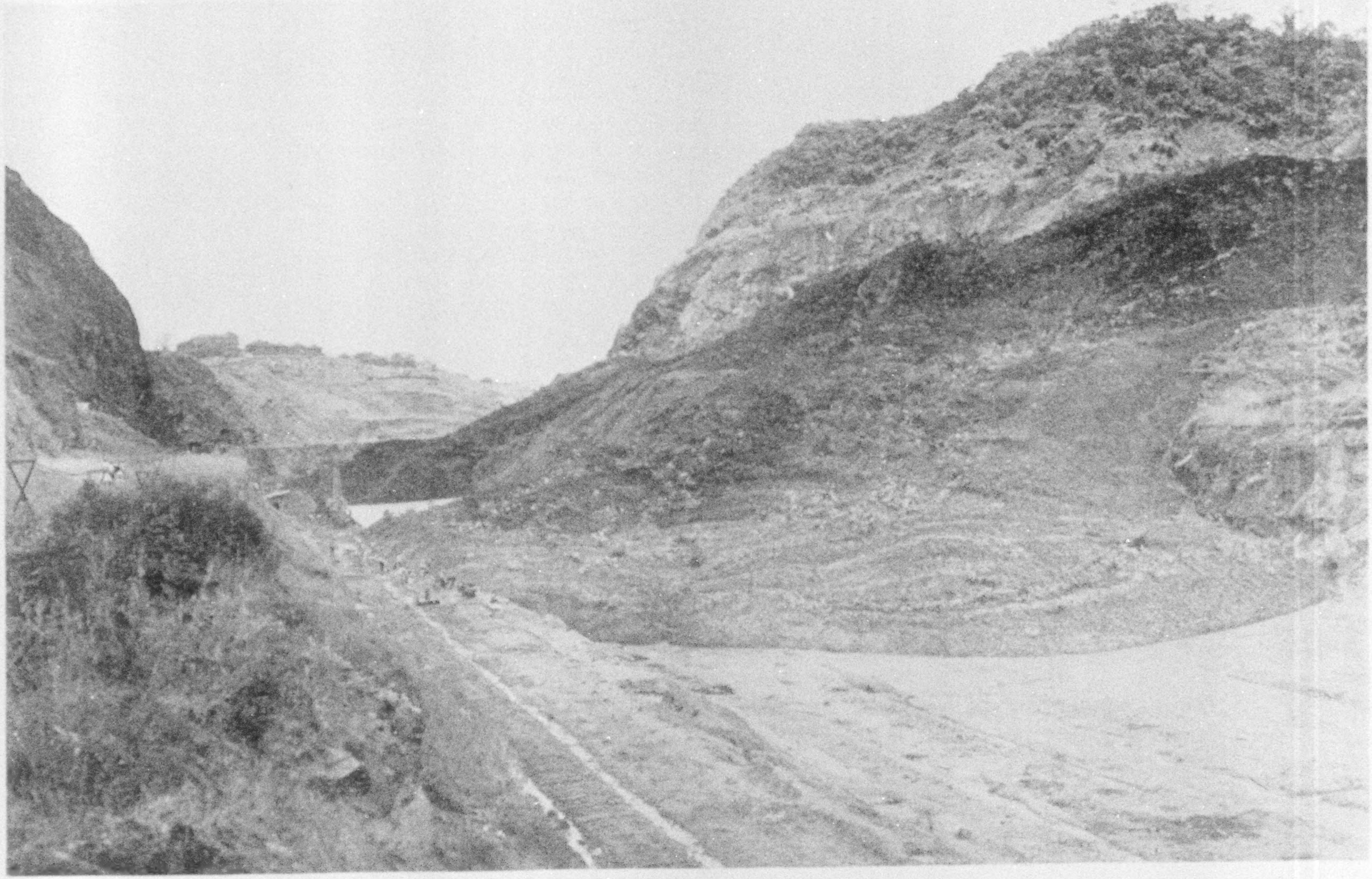
The causes of the slides at Panama must be traced to the geologic history of the Isthmus. There are 11 groups of bedded rock and six of igneous rock on the canal line. The two oldest rocks are the Bas Obispo formation and the Las Cascadas agglomerate. Neither contains any fossil remains, and so their age cannot be fixed with any degree of definiteness. The Bas Obispo formation is of volcanic origin and crops out at Bas Obispo, Miraflores, and Old Panama. The Las Cascadas agglomerate is made up of basalt breccia, cemented together with volcanic clay and tufa and other lava flows.

Culebra Cut contains fossils of sea-living animals, thus proving, along with other evidence, that this great barrier which has stood between man and his dream for more than four centuries was once at the bottom of the sea.

It is stated that Gold and Contractor's hills, which now stand as the huge posts of the Panama Gateway, are composed of comparatively young volcanic rock blown up to a height some 300 feet or more above their present summits, and that they settled down to their existing level soon thereafter. The evidence of the rocks of the Isthmus is that there were two eras of volcanic activity, the one of terrific force and the other much more gentle, with a long quiescent period between them.

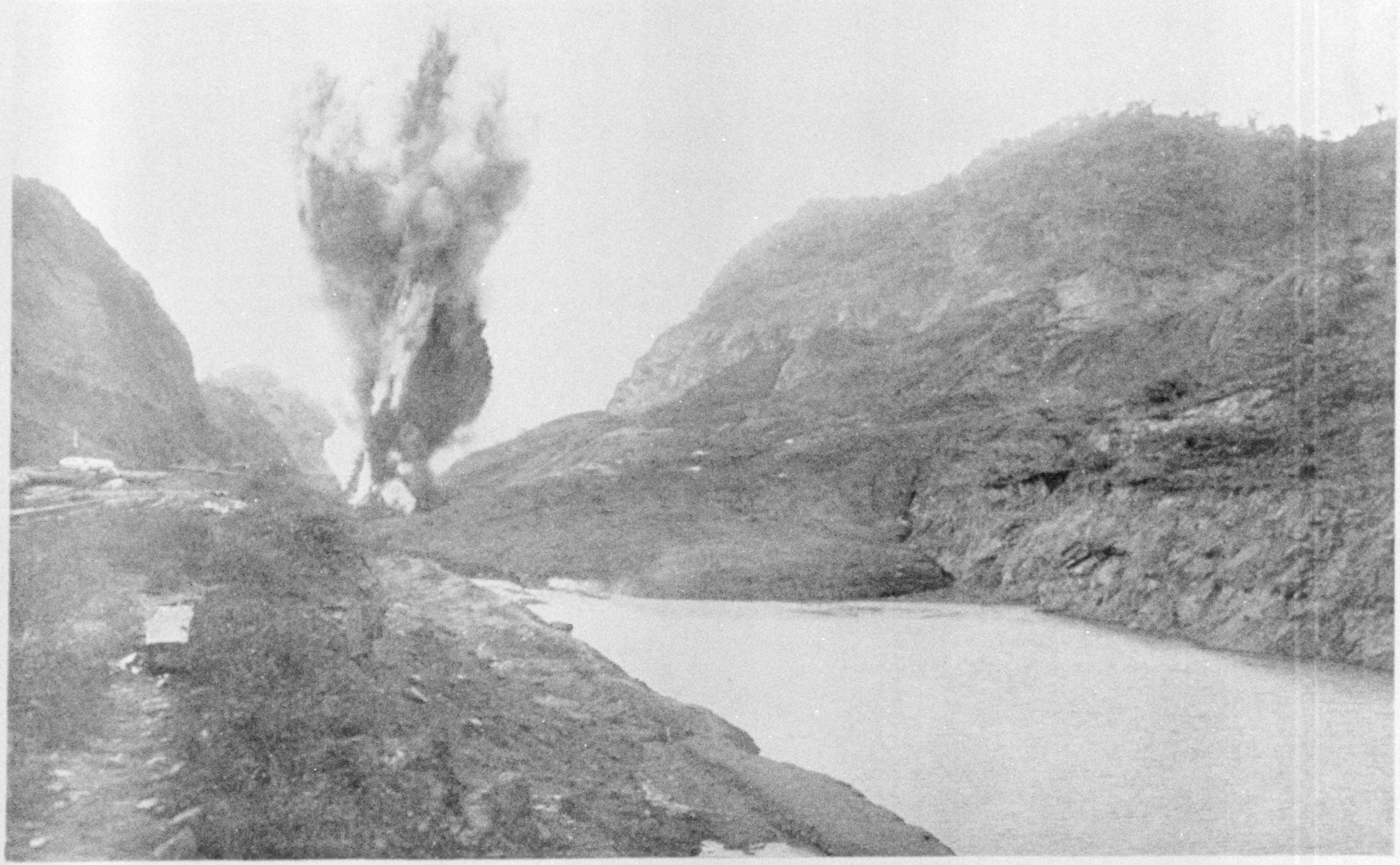
During the first volcanic era islands arose in the shallow ocean that linked the Atlantic and the Pacific. During the second period the whole land arose and the rivers became active, assorting the rocks as they hurried to the sea. The original bed of the Chagres at Gatun, as it existed then, is now 375 feet below sea-level. After this the ground sank to 8 feet below its present level on the Atlantic side and to 25 feet below its present level on the Pacific side. This level seems to have been maintained until a time approximating the dawn of the Christian era, when it rose to the present level.

Interesting proof of this is afforded some 80 miles from Ancon. The Indians there have been using the contents of a shell mound, found at the base of a 75-foot hill, for burning lime. The plain here is about 25 feet above sea-level. The mound contains many varieties of shells and much broken crockery, indicating that it was once used as a kitchen midden. About 2 inches of soil cover these deposits, and near-by is a place which shows that it was used as a canoe



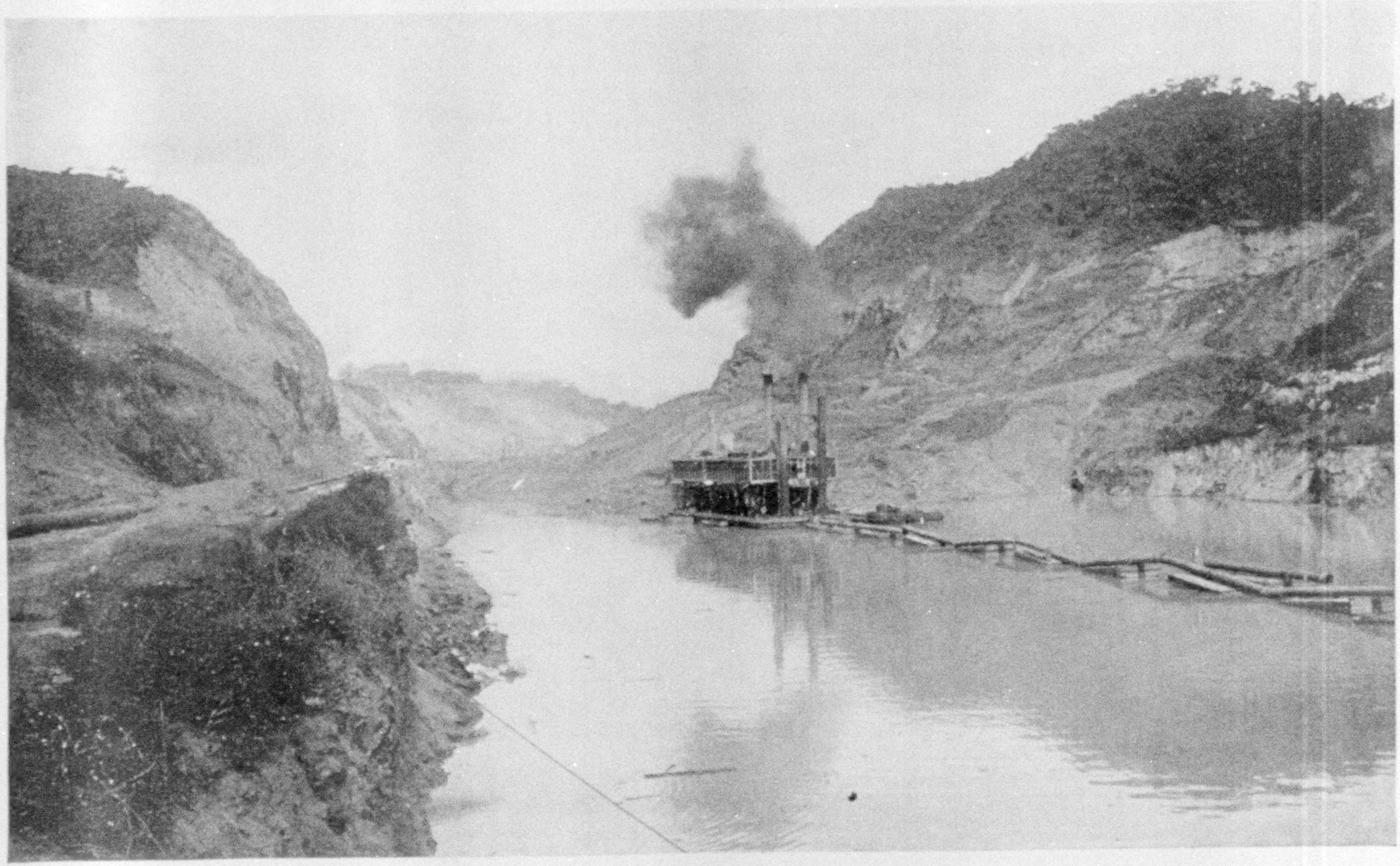
CUCARACHA SLIDE BEFORE THE CUT WAS FLOODED

This slide "so prevented the work from going forward that Colonel Goethals finally determined to let the water in and to dredge her out" (see text, page 141). This is the last photograph taken before the cut was flooded



BLASTING A CHANNEL THROUGH CUCARACHA SLIDE

The slide completely blocked the canal, and, in the attempt to force a channel through it, a mass of dynamite was buried and exploded on October 16, 1913



A DREDGE REMOVING THE SLIDE

This dredge came from the Pacific side, and across the slide can be seen the smoke-stacks of the dredge that came from the Atlantic through the Gatun locks. Note the pipe-line through which the dirt from the slide will be pumped away to a safe place.

landing, while the remains of an ancient fishing village are in evidence.

The intention of the canal engineers is to cover the banks of the canal through Culebra Cut with vegetation in order to prevent those small slides that come down through erosion. As soon as the angle of repose is reached this work of tropical forestation will begin, and when the ships of the future use the canal they will sail between banks of tropic green except at those places where the living rock defies the efforts of the forester.

I can find no more striking way to convey to my readers the meaning of the slides at Panama than by asking them to remember that at one place where the consulting engineers said the slope should be such as to give a top width 670 feet that width is now 1,800 feet; the vastness of the difficulties created by this difference can thus be somewhat appreciated.

It is a most striking thing to look back to the days of the consulting engineers, in the light of what the completion of the canal has shown, and to see how well they appreciated conditions in Culebra Cut, especially those who advocated a sea-level canal. These men were so sure that they knew what was beneath the soil of Culebra Mountain that they did not hesitate to proclaim with confidence that Culebra Cut dug to 40 feet below the sea was no problem except that of removing material.

A member of the Isthmian Canal Commission of 1899-1901 testified that it was thoroughly known exactly what materials would be encountered in the cut, and the consulting engineers, taking their cue from this, reported that the whole proposition was an easy one. Henry Hunter, chief engineer of the Manchester Ship Canal, was so sure that a sea-level Culebra Cut would present no difficulties that he announced it as his belief that such a cut could be completed long before the locks of a lock canal could be built.

The entire majority declared that it was as clearly demonstrable as anything of such a nature could be that it would be possible to use a hundred steam shovels in the cut alone, and that a sea-level cut could be finished in 11 years at the outside.

One engineer laughed at the idea of encountering any trouble from Cucaracha slide. "Why, I have tramped over it every day for months, and with my experience with such slides I know that it is only a question of proper drainage."

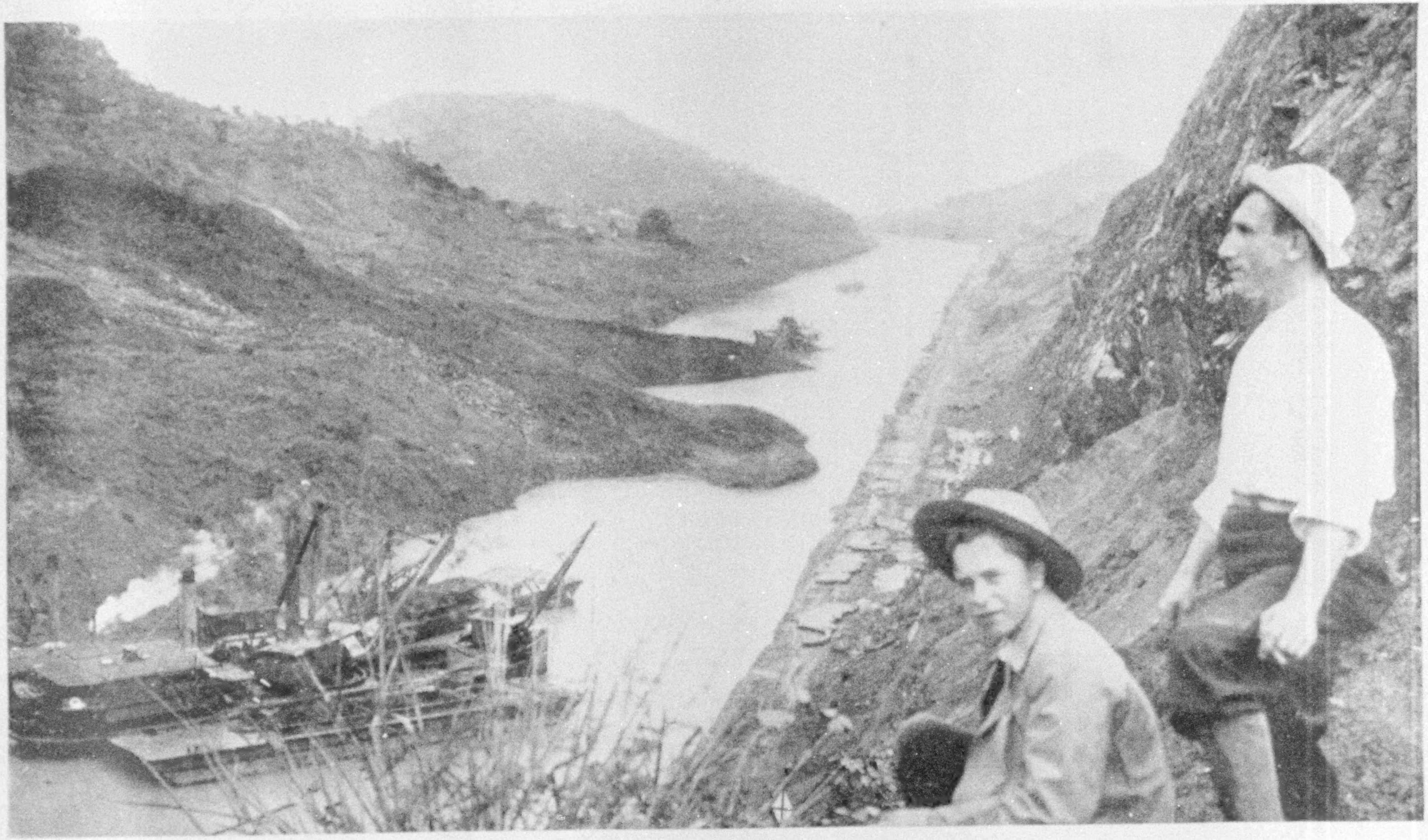
Never did any set of men miss a proper statement of conditions that would be encountered more widely than the majority of the board of consulting engineers. They said the banks would stand up; that there would be no slides; that a hundred steam shovels could be used in Culebra Cut; that the cut could be built to sea-level in less time than it would require to construct locks; that a sea-level cut would require the excavation of only 110 million cubic yards of earth.

The facts are that the banks failed to stand up, to the tune of 30 million cubic yards; that there have been over 250 acres of slides; that no more than 40 steam shovels ever could be worked in Culebra Cut; that locks a fourth larger than those the majority members of the board of consulting engineers had in mind were built in less time than even a lock-level cut was dug, and that a lock-level cut has required the excavation of almost as much material as they said a sea-level cut would require.

A FORTUNATE CHANGE OF PLAN

The American people may thank their stars that at such a juncture as we were facing at the time the consulting engineers made their report, there was a man in the White House and a man at the head of the War Department who dared ignore the recommendations of the majority of that board.

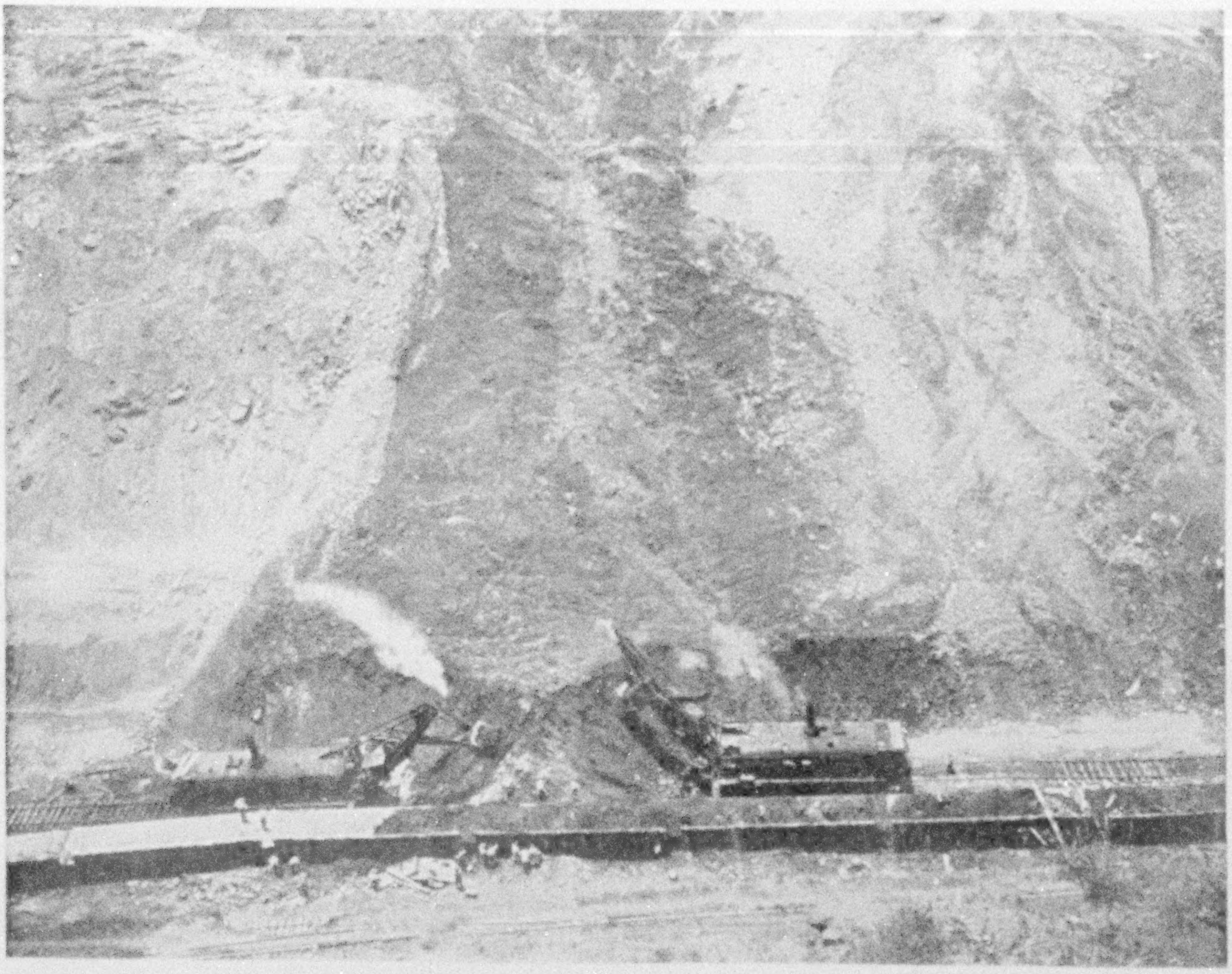
Had the change to a lock canal not been made we would have worked up to about the present time on a sea-level canal, digging a tremendous ditch all through that broad country from Gatun to Gamboa, 20-odd miles, building a six-million-dollar set of tidal locks at Sosa Hill, building a six-million-dollar masonry dam at Gamboa, and doing divers other things unnecessary to a lock canal, at a total cost of some $50,000,000, only to find, after all, just as the French discovered, that a sea-level canal could not be built within the limit of money and patience set by the people behind the project.



Courtesy of New York Herald

DREDGING AWAY THE SLIDE

Here we see the Cucaracha slide after the water was let in and the dredges had got to work on it. It is composed mainly of clay, and by placing a relay pump in the pipe-line the clay can be sucked out and pumped over the banks of the canal out of harm's way



STEAM SHOVELS REMOVING CUCARACHA SLIDE

This particular slide, one of the many, completely filled the canal. The flat cars are standing on the west bank of the canal, 70 feet above the bottom of the cut

We would either have been forced to acknowledge a humiliating defeat or to have started at this late date to transform the sea-level canal that was to have been into a lock canal such as we have now. It is very easy to imagine that, with a sea-level canal fiasco staring them in the face, the American people might not have been willing to accept the lock canal, with its Gatum Dam and its great locks, and there would have been no canal in the end.

WHY A SEA-LEVEL CANAL WAS IMPOSSIBLE

Let us consider for a moment, in view of what actual work has proven, how much more excavation would be required to bring the present cut to sea-level. We have seen that the slides have grown vastly more serious as the cut has deepened.

During my last trip to the Isthmus I asked every engineer I met, from Colonel Goethals down, to estimate for me, roughly, how much more material would have to be removed from the cut to bring it to sea-level. Not one of them would risk a prediction, but all agreed that it would be more than cross-section measurements plus the slide experience of the fiscal year 1913 would indicate.

Such a cross-section measurement would involve about 50 million cubic yards. Even if the slides were no worse than they were in 1913, the extra excavation which would be required to convert the present cut into a sea-level cut would amount to approximately 75 million cubic yards.

The probabilities, therefore, are, in the light of experience, that it would require the removal of as much more material as has been taken out to make a sea-level cut; in other words, that from the vantage point at which we stand today we might fairly conclude that a sea-level Culebra Cut would have required the excavation of 210 million cubic yards of

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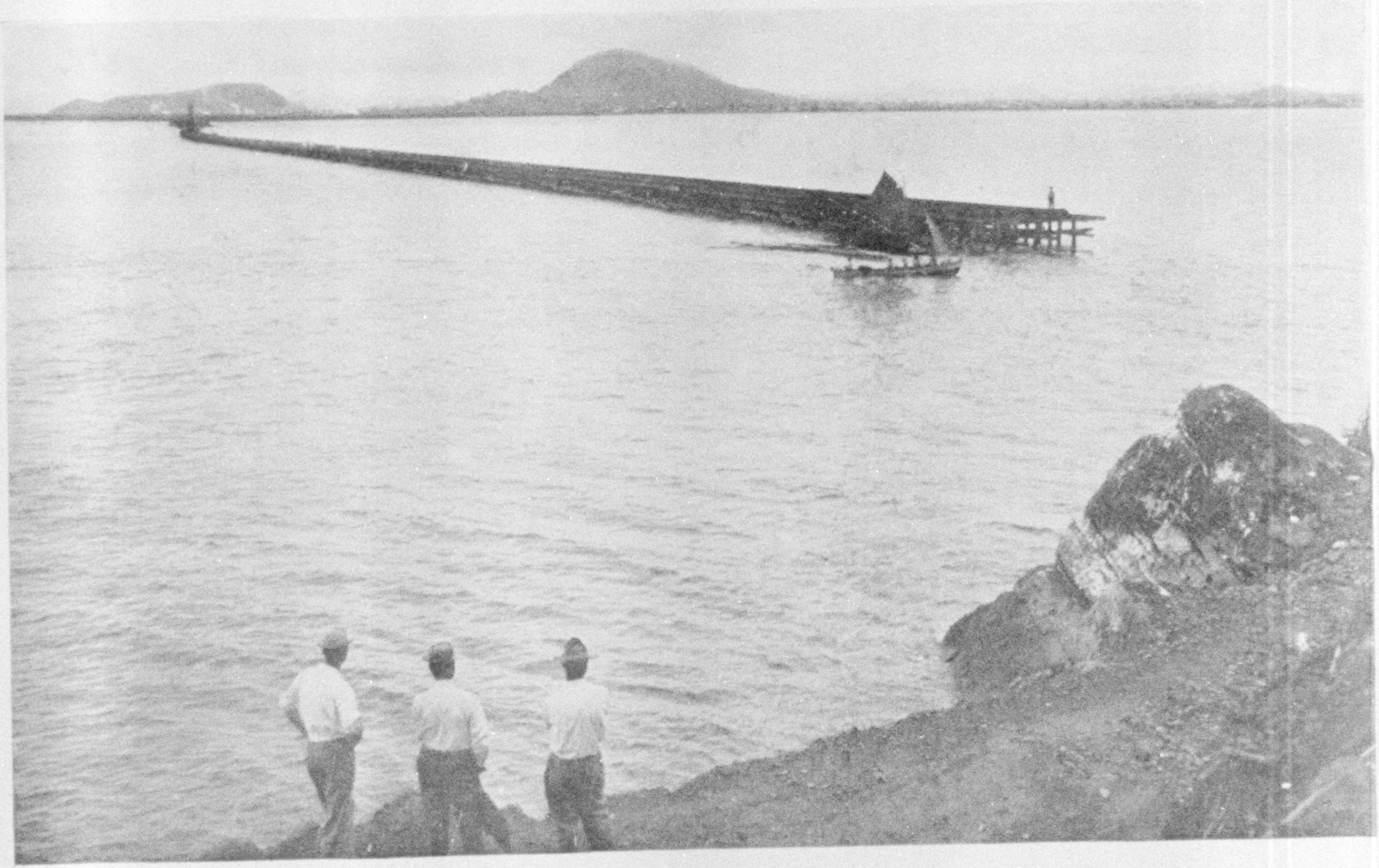

BUILDING THE NAOS ISLAND BREAKWATER

At both the Atlantic and Pacific ends of the canal great breakwaters have been built to afford protection to the shipping and to keep the channels free. This Naos breakwater at the Panama end is 17,000 feet long and is built of material excavated from the Culebra Cut. The rock was dumped into the water from railroad trucks which ran along the wooden trestle shown in the picture.

material instead of the 110 million cubic yards the majority members of the board of consulting engineers fixed.

But suppose such a prospect would not have staggered the American people into a refusal to go further with a sea-level canal, what would we have had when it should be completed? A tortuous channel, with a tidal lock at the Pacific end in greater danger of destruction than those at Gatun; a masonry dam at Gamboa nearly twice as high as Gatun Dam and a much fairer mark for the dread man in the flying machine; a canal in which not one of the recently built big ships could be handled, making it out of date before its completion.

When the American people come to celebrate the opening of the present canal, they owe a hymn of thanksgiving to that happy fate that led them—yes, led them against their will—to build a lock canal at Panama. To have pursued the course the majority of us—for I am one of that majority—wanted the United States to pursue would have involved us in one of the most calamitous undertakings in all history.

The meaning of the slides cannot be misunderstood or misinterpreted. They mean that Nature would have interposed such tremendous obstacles in the way of a sea-level cut through Culebra Mountain that even the might and power and wealth of the giant of the household of nations would have arrayed themselves against her in vain had that nation determined upon the wedding of the oceans by the commingling of their waters at Panama.

In conclusion, I wish to call attention to a story that seems to find acceptance in some quarters. It is to the effect that shipping and insurance circles stand in dread of slides in the future in the canal.

There are two reasons why there is not the slightest ground for that dread, even if there should be for the story. In the first place, the canal is not going to be pronounced a finished waterway until every yard of debris that can come in has arrived and has been removed. In the second place, the United States government has pledged its solemn word, through definite legislation, to indemnify any ship-owner for delays or damages caused by the canal or its operatives. And Uncle Sam makes the process of recovery easy and prompt in its action.

When the shipping of the world passes through the great waterway, some time this year, it will behold the most wonderful shipway that ever has opened its gates to the nations of the earth. And there will be read in the majestic proportions of the present Culebra Cut the reason why a sea-level canal was not built, and why it could not be built within the toiling and money-spending power of the United States.

THE PANAMA CANAL*

By Lieut. Colonel William L. Sibert, U. S. Army

Engineer in Charge of the Atlantic Division

For a map of the Panama Canal, see "Bird's-eye View of the Panama Canal," 9 by 18 inches, in National Geographic Magazine, *February, 1912, and also "Map of Central America, etc.," 12 by 19 inches, in the February, 1913, number.*

The Panama Canal, as all know, is being built by the President of the United States through a commission of seven members, the chairman and chief engineer of which is Col. George W. Goethals, of the Corps of Engineers, United States Army. As a member of the commission and as division engineer of the Atlantic Division, I have had charge of the construction of the Gatun locks, the Gatun Dam, the breakwaters in Colon Harbor, and the excavation of the channel between the Gatun locks and the Atlantic Ocean.

If there are any people who yet hold the idea that the waters of the Atlantic

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*An address to the National Geographic Society, November 29, 1913

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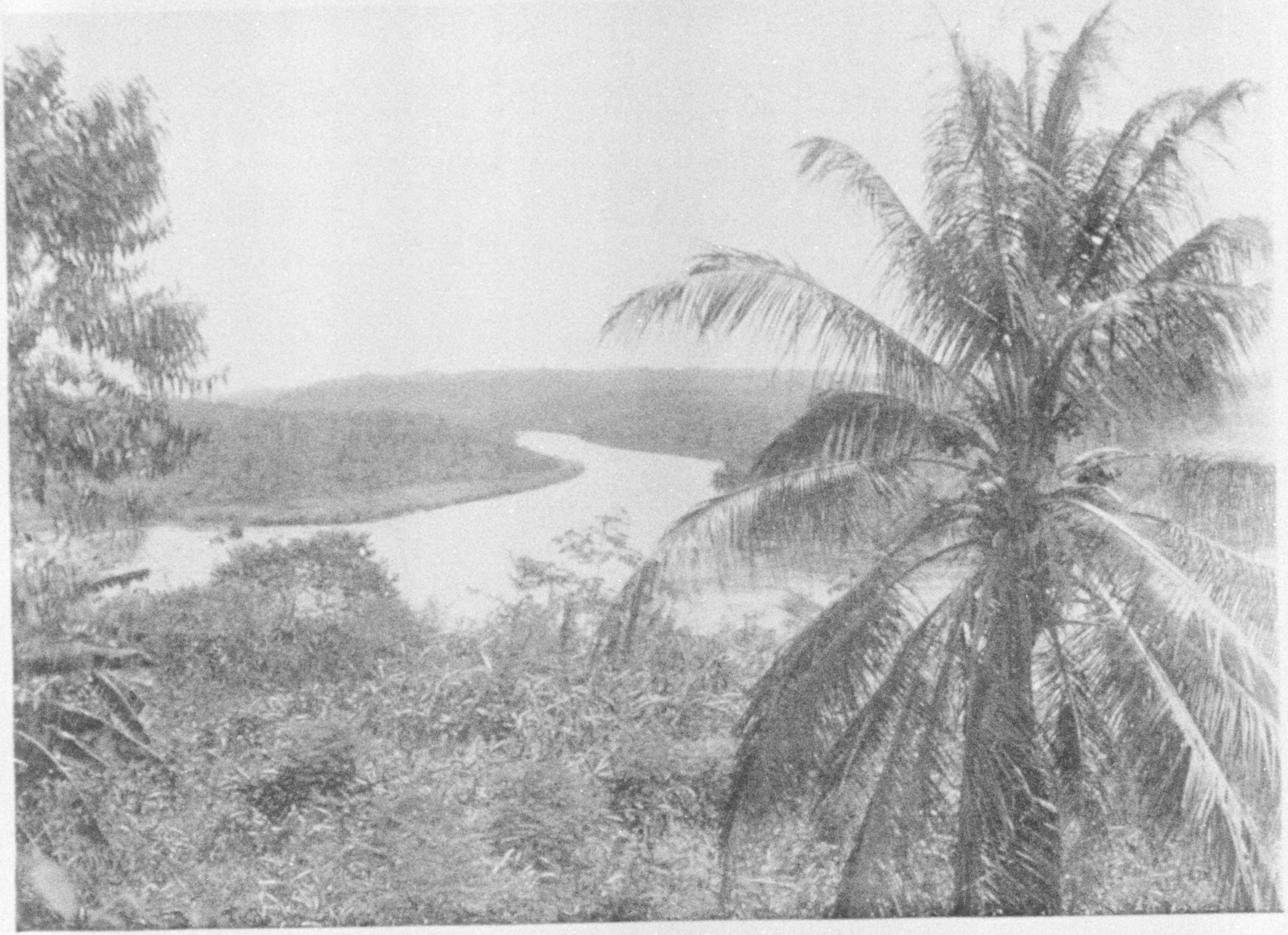
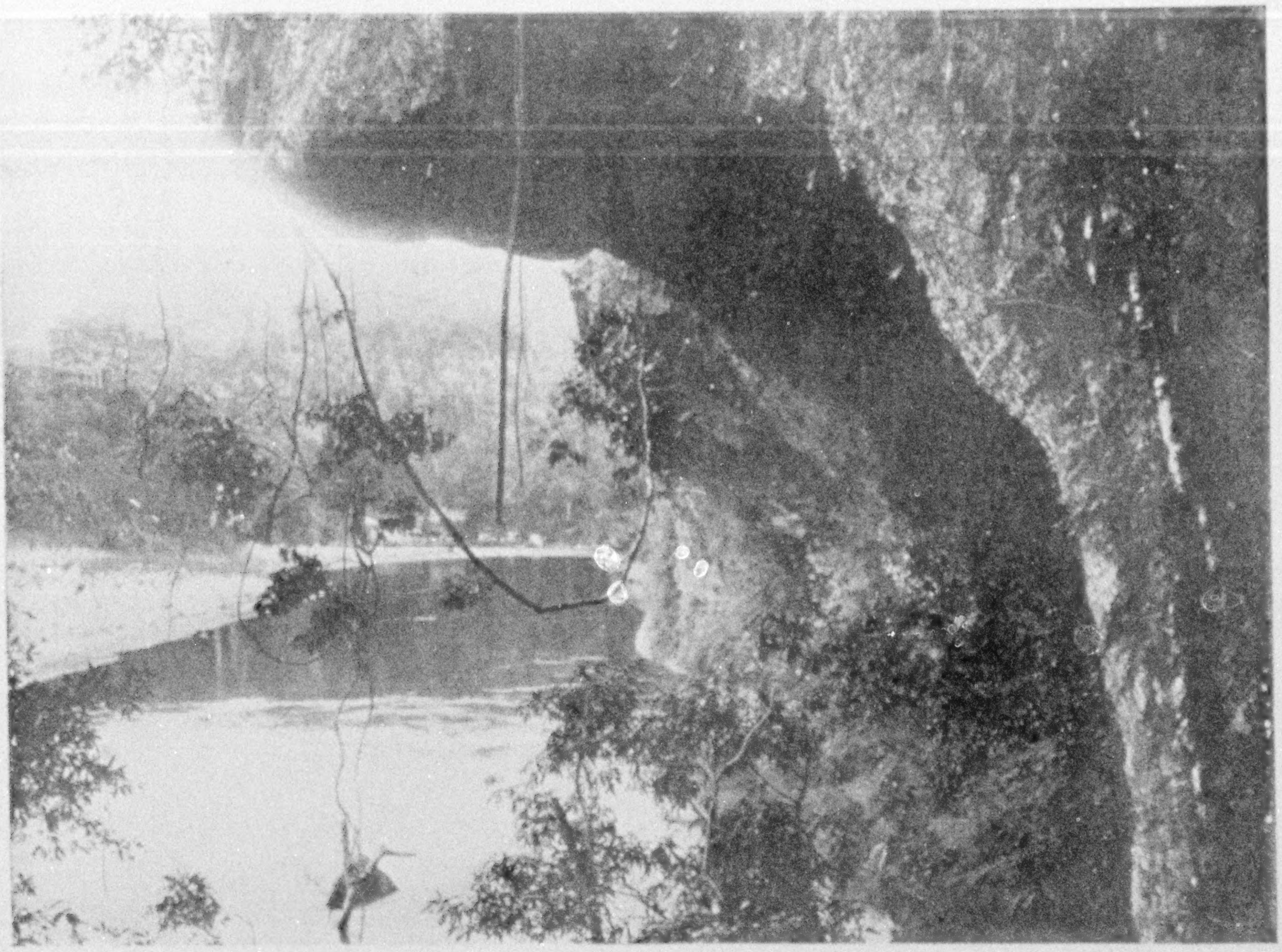


A VIEW ON THE CHAGRES RIVER

It is the Chagres River that has made the Panama Canal possible. It supplies the water for the Gatun Lake—the largest artificial lake in the world—across which the vessels will steam for nearly two-thirds of the entire distance from coast to coast



ON THE UPPER CHAGRES

This picture gives some idea of the many beauty spots found along the banks of the Chagres River

and Pacific will mingle in this canal, I think that two statements of fact will dispel that idea forever.

One of the statements is that for about 32 miles this canal is 85 feet above the level of the Atlantic and Pacific. The second statement is that water will not flow uphill.

HOW THE CANAL IS DESIGNED

What has really been done is that a great dam has been built across the lower end of the valley of the Chagres, entirely blocking the flow of that river to the sea. The height of the dam and spillway is so fixed that the Chagres River will rise and rise until it reaches a stage 85 feet above the level of either ocean. At this stage the Chagres River will form a lake 165 square miles in area and 45 feet above the bottom of the cut that has been made through the Continental Divide at Culebra.

The Chagres, therefore, can flow into both oceans—to the Atlantic through the locks at Gatun and to the Pacific through the locks at Pedro Miguel and Miraflores. The water of the Gatun Lake not needed in passing ships through the locks goes to the Atlantic Ocean through a spillway (see page 170).

THE BREAKWATERS AT COLON

Starting at the Atlantic side, the first work that has been done is the construction of the west breakwater at Colon. It was thought that that breakwater would be sufficient to insure a safe harbor. The line of the canal at Colon is due north and south, and the most destructive storms, the "northers," are from a little west of north; so that the west breakwater will provide a safe anchorage for ships during such storms.

The prevailing winds at Colon, however, are the trade winds, that blow from the east or north and continue for more than nine months of the year. These winds do not produce a sea destructive to shipping, but they make a rough har-

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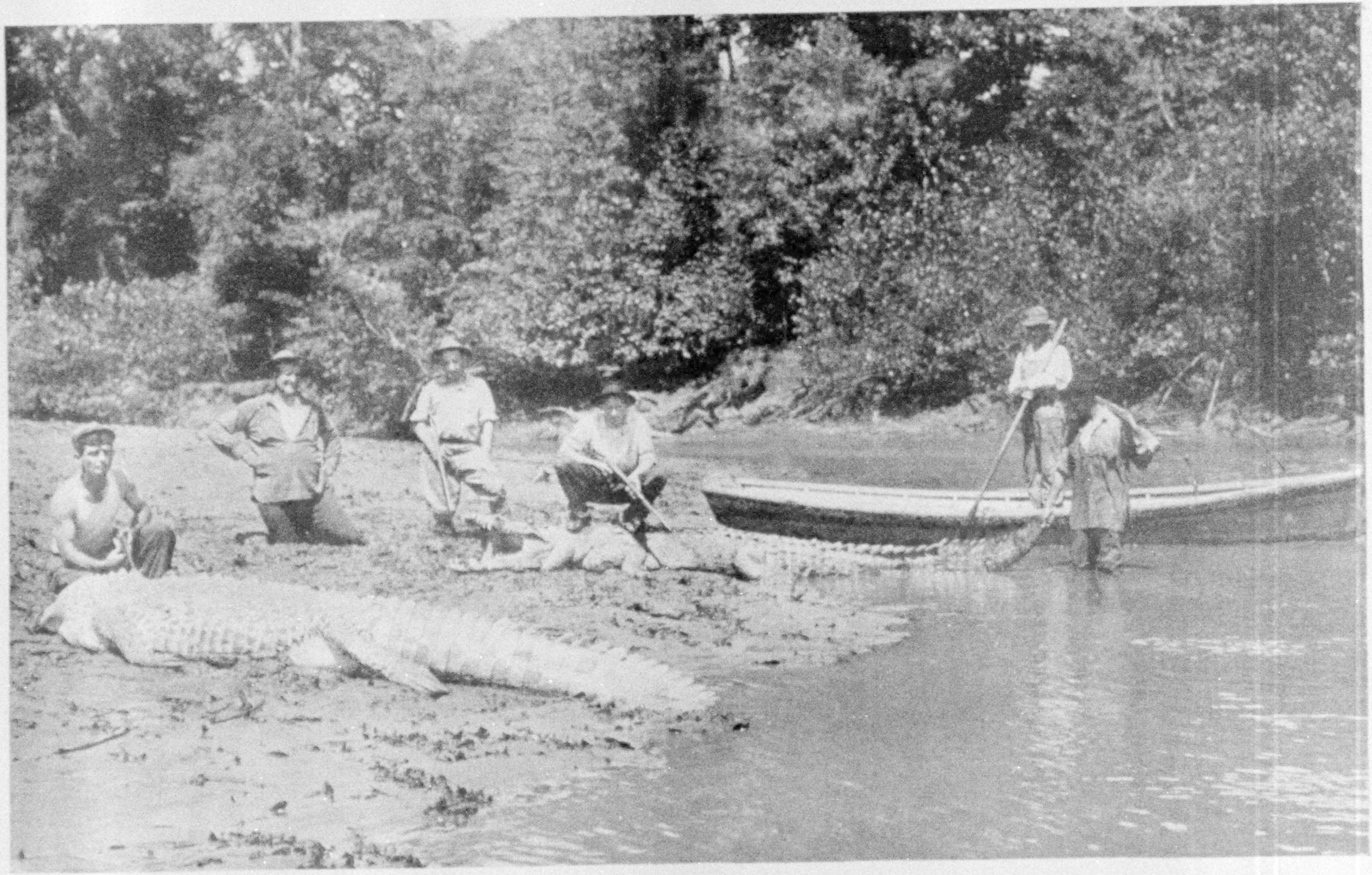


SPORT ON THE CHAGRES

One of the diversions very popular among the sporting members of the canal staff was alligator hunting. The upper waters of the Chagres could usually be relied upon to produce excellent sport, though these great reptiles are found in all the principal streams on the Isthmus bor, stir up the soft bottom of Limon Bay and create currents, with the result that there is a large amount of silting in the channel through the bay. For two years in succession this silting amounted to more than two million cubic yards of material.

In order to remedy this condition, and for other reasons, it has been decided to construct an east breakwater also. Its end will be opposite the end of the west breakwater, leaving an opening of 2,000 feet. When this breakwater is completed, the silting in the channel will cease and all difficulties of transfers from one boat to another in the harbor will be eliminated. The west breakwater should be completed in the summer of 1914, and the work on the east breakwater has just commenced.

HOW THE BREAKWATERS ARE BUILT

The method of building the breakwaters is as follows:

A trestle, suitable for a double-track railroad, was driven from the shore, extending for two miles out to sea. The rock forming the bottom of the breakwater was run out on cars and dumped or plowed off until the fill was made alongside the trestle to an elevation of 15 feet below sea-level (compare page 152). Between that level and 10 feet above sea-level the breakwater was built of hard trap rock, obtained from Porto Bello, the stone ranging in weight from 1,500 pounds to 15 tons.

The stone for the armor of the breakwater, as well as all crushed stone for the Gatun locks, came from this seacoast town of Porto Bello, situated some 20 miles northeast of Colon.

This place has given all kinds of trouble. The first year we attempted to crush stone for the Gatun locks, we had at Porto Bello a rainfall amounting to 237 inches—3 inches less than 20 feet; 9 feet of rainfall in two months; 58 inches in one month.

Everything happened at Porto Bello that could happen. Slides that no engineer would dream of occurring did occur. On an average 300,000 cubic yards of crushed stone every day were necessary for the concrete at Gatun. We had a young officer of engineers there, Captain Stickle, who was doing the best he could, but we were pushing him anyway; so, after he had been urged and urged and then urged again to do more, one day he sent a wireless, "Fifty-eight inches of rain this month. Anything over fifty inches considered an act of God."

THE FRENCH CANAL WOULD HAVE BEEN USELESS NOW

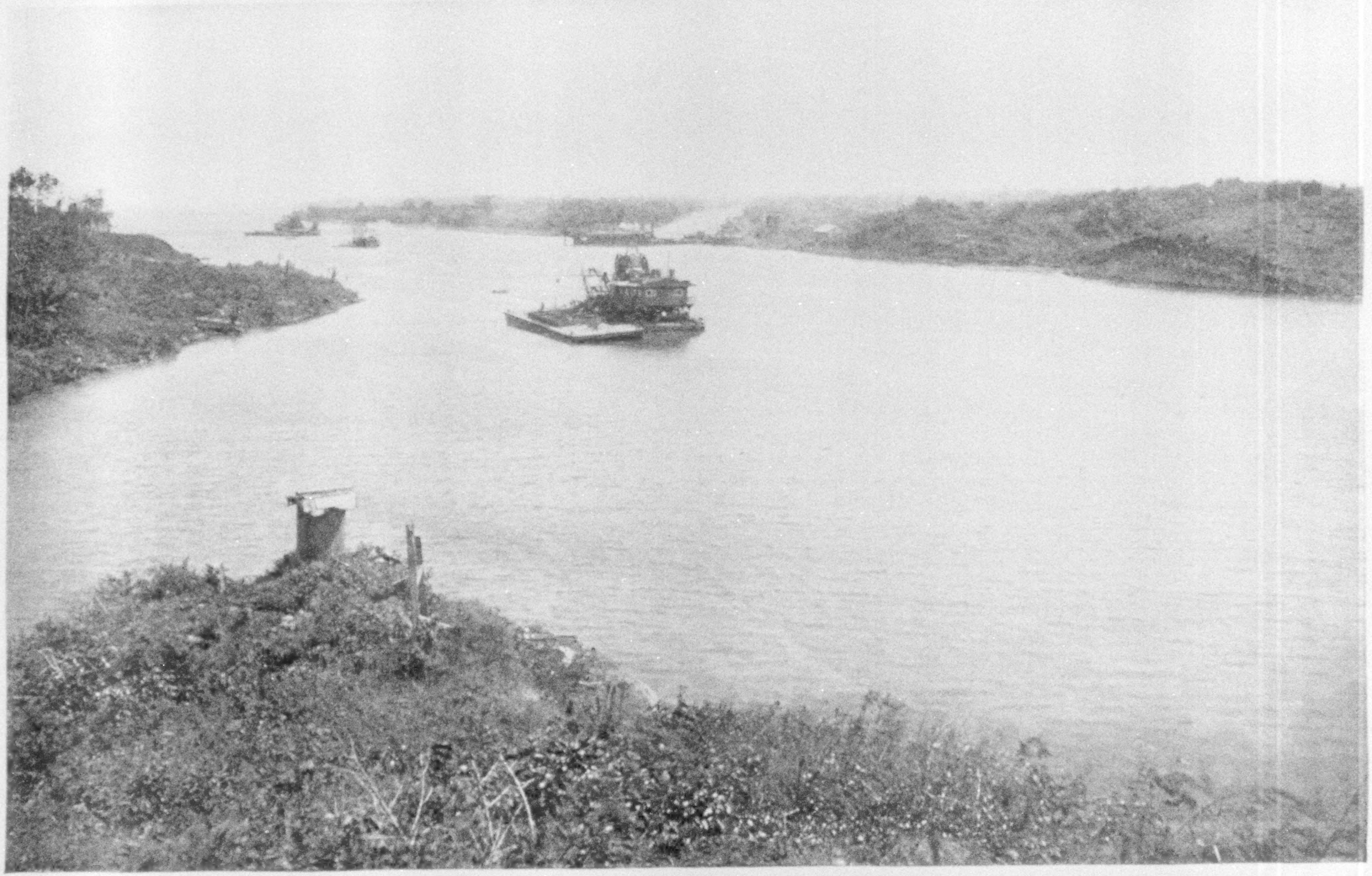
A little to the north of the Gatun locks the American and French canals intersect, and the picture on page 158 shows the relative sizes of the two. Had the French canal been completed it would now be out of date, for its locks would not be of a size sufficient to pass the boats that would now offer.

In the French project the sea-level part of the canal on the Atlantic side extended about 10 miles farther up the Chagres Valley than the American project. The water supply would have been materially less than in the American plan and would not have been sufficient for the substitution of locks of the size now built, and those now adopted are none too large to meet the requirements of Congress that the Panama Canal should be built of such size as reasonably to meet the demands of the future as to the size of ships.*

The canal is at sea-level from the Atlantic to Gatun; it then goes up a flight of three steps to Gatun Lake and continues at that level for 32 miles. Then down one step at Pedro Miguel to Miraflores Lake, which is 55 feet above sea-level; thence through the Miraflores locks, and the canal from there to the Pacific is at sea-level again.

The proudest day that Gatun has yet had was on the 26th day of September, 1913, when the little tugboat *Gatun* was lifted from sea-level to the surface of Gatun Lake, and was the first boat to pass through any lock of the Panama Canal (see page 162).

*The full length of each lock compartment is 1,000 feet. The largest ship in the world, the *Vaterland*, of the Hamburg-American Line, which is not yet completed, has a length of 950 feet. While it is unlikely that the huge liners used in the transatlantic passenger service will often be required to pass through the canal, still the locks are big enough to accommodate the largest ship in the world.



A COMPARISON OF THE FRENCH AND AMERICAN CANALS

This is a picture looking toward the Atlantic Ocean from the Gatun locks at the point where the present canal crosses the French excavations. Had the French canal been completed, it would now be out of date, as it was much smaller than the present one and its locks would not be of a size sufficient to pass the large ships of the present day.

As soon as a boat passes the lower lock gates they are closed behind it, and water is let into that box or lock chamber from the lock above until the same level of water exists in the lower and middle locks, the boat being lifted 28⅓ feet in this operation. After that the gate separating the lower and middle lock will be opened and the boat will pass into the second lock, the gates closed behind it, and the process repeated, the boat being lifted another 28⅓ feet. That operation repeated once more will cause the boat to float out on the level of Gatun Lake.

The filling of the lower chamber of Gatun lock for the first time is shown in the picture on page 164. The gate on which all the men are standing is called the east gate or guard gate. These gates were completed as soon as practicable and then closed, so as to keep the sea out of the locks while dredges were completing the excavations in the lock entrance, thus not interfering with the work on the other gates nor with the machinery installation.

PAINTING MOSQUITOES

On both sides of the channel at Gatun were extensive swamps. They were great breeding places for mosquitoes, and in digging the channel through the soft, swampy bottom pipe-line dredges were used. These dredges cut up the material near the suction of the pumps, draw it in with water, and force it long distances through pipe-lines. In making the channel excavation those swamp areas were built up high enough to enable the sanitary department to drain them.

In 1912 Gatun had probably the greatest influx of malarial mosquitoes in its history; they came by the thousands. The Gatun Lake was rising at that time, and it was not known whether these mosquitoes were coming from that lake or not; so the sanitary department determined to locate all the breeding places for mosquitoes near Gatun, catch mosquitoes at each place, and after painting them turn them loose, and determine by the color of the mosquitoes caught in Gatun from what point they came.

It was found that the largest breeding place was off to the west of the locks, in an old swamp that had given no trouble previously. A few mosquitoes had bred in this place all the time, but there were enough wild animals in the swamp to supply food, so the mosquitoes were not forced to migrate. When salt water was pumped into the swamp water, making the mixture about 30 per cent salt, mosquitoes began to breed by the trillions

I went down there one morning to see how the mosquitoes were caught and painted. Walking along the edge of the water, mosquito bars were seen suspended from limbs tied up at the bottom. They had thousands of mosquitoes in them ready to be sprayed with a colored liquid, and the sanitary inspector was asked how he caught them.

He said, "We have a more scientific way, but this had to be done in a hurry. We simply let the mosquito bar down, as you would over a bed, left one side of it open, and put a Jamaica negro in there for bait." As soon as the mosquito bar was full the bait was removed and the end tied up.

I saw some Jamaican negroes sitting out in front, and I said to one fellow: "John, were you the bait in that bar?" and he replied, "Yes, boss; that is the easiest money I ever earned—ten cents an hour for sitting there and doing nothing but just inviting the mosquitoes in."

THE DREDGING FLEET

Just prior to the time that water was let into Culebra Cut, a fleet of dredges was brought up preparatory to removing Cucaracha slide, the last one that obstructed the passage across the continent. The picture on page 166 shows part of the fleet assembled for passing through the locks, and gives a good picture of a pipe-line dredge, showing the cutter in front. When this cutter is revolved, those blades loosen the dirt, the intake of the pump is just behind, and when the water is drawn in by the pump it carries in from 15 to 20 per cent of solid matter, and the pump gives it velocity enough to be carried from one-half to three-quarters of a mile through a pipe.

The entire dredging fleet is shown in the picture on page 167. There were

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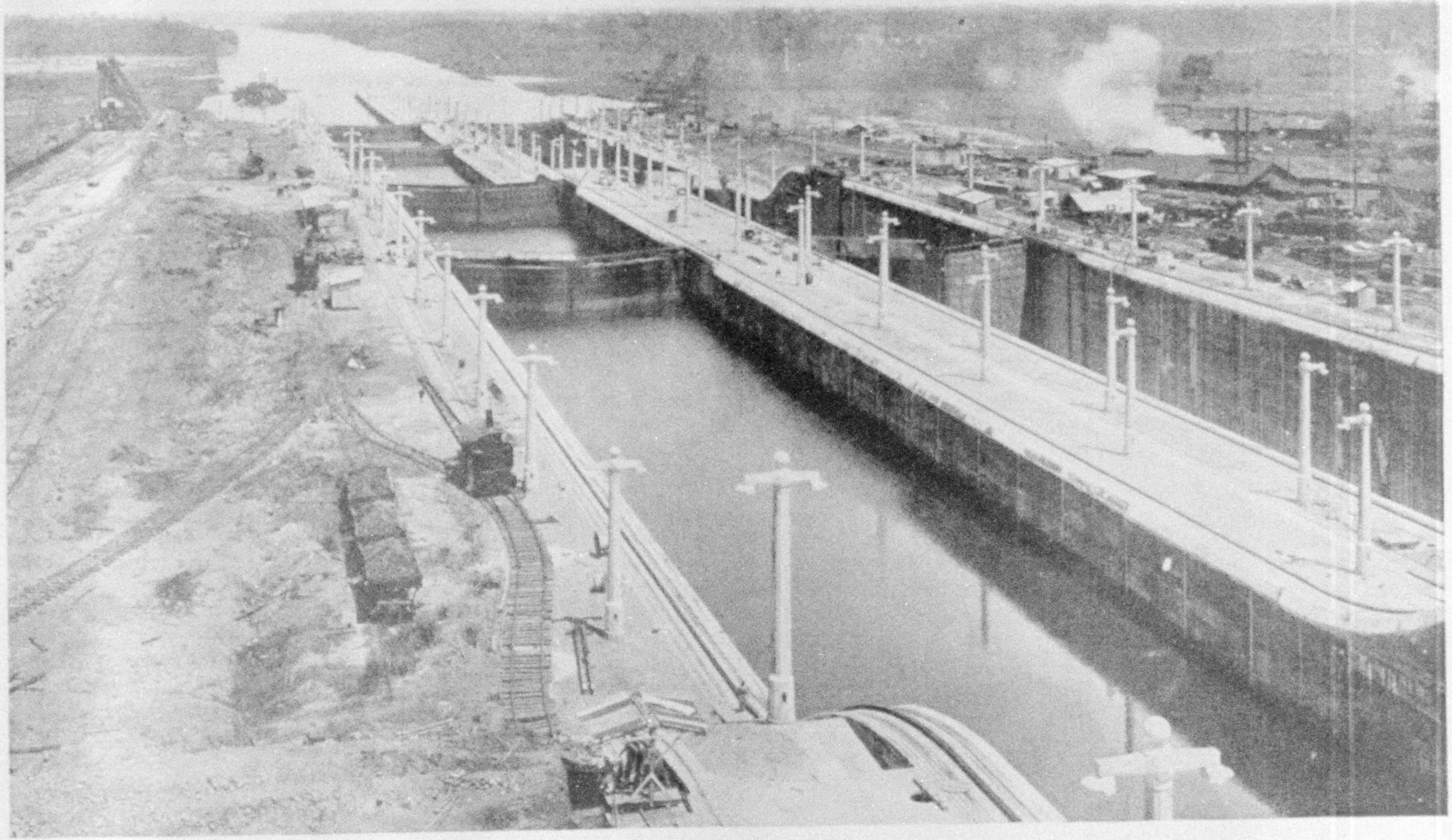
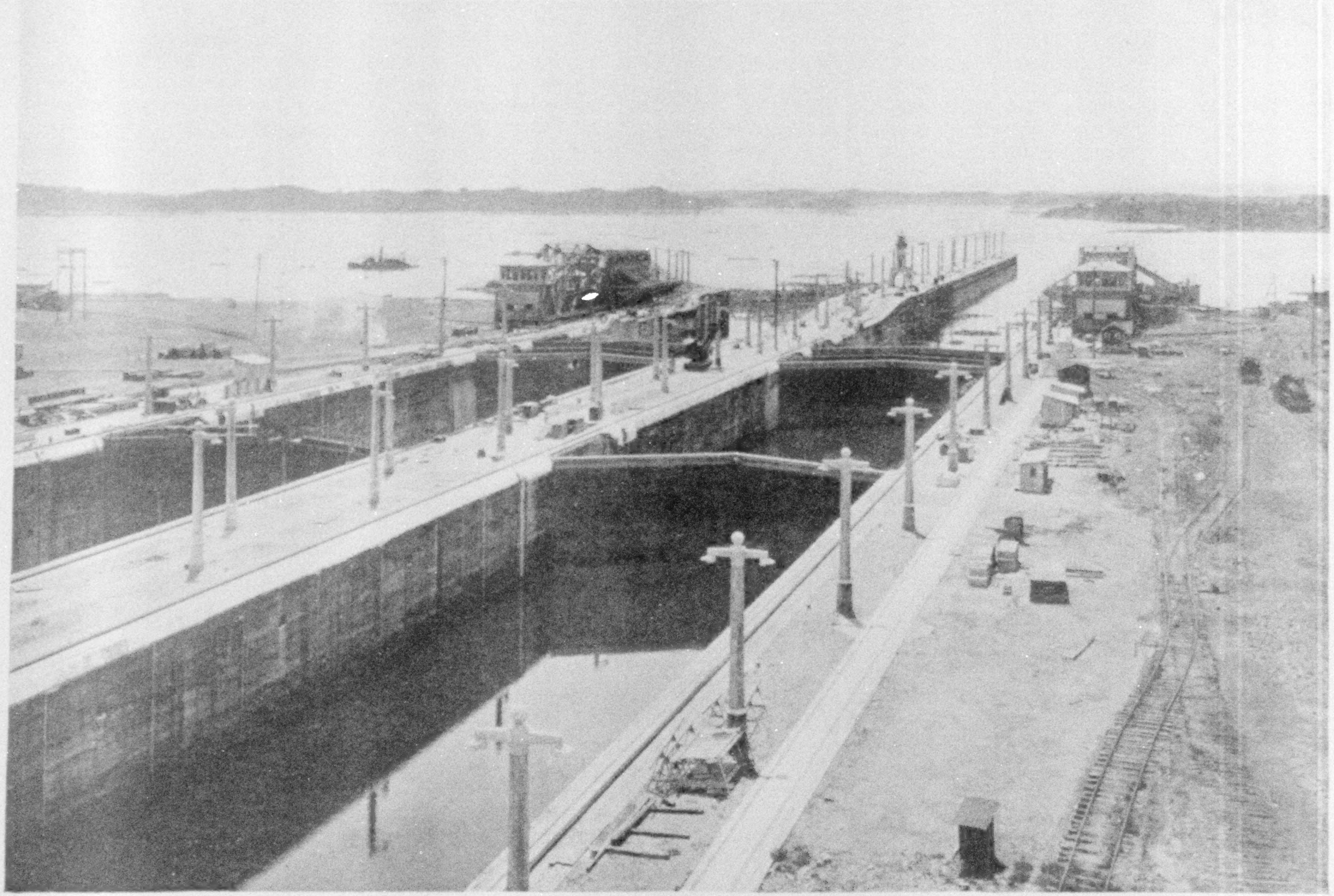


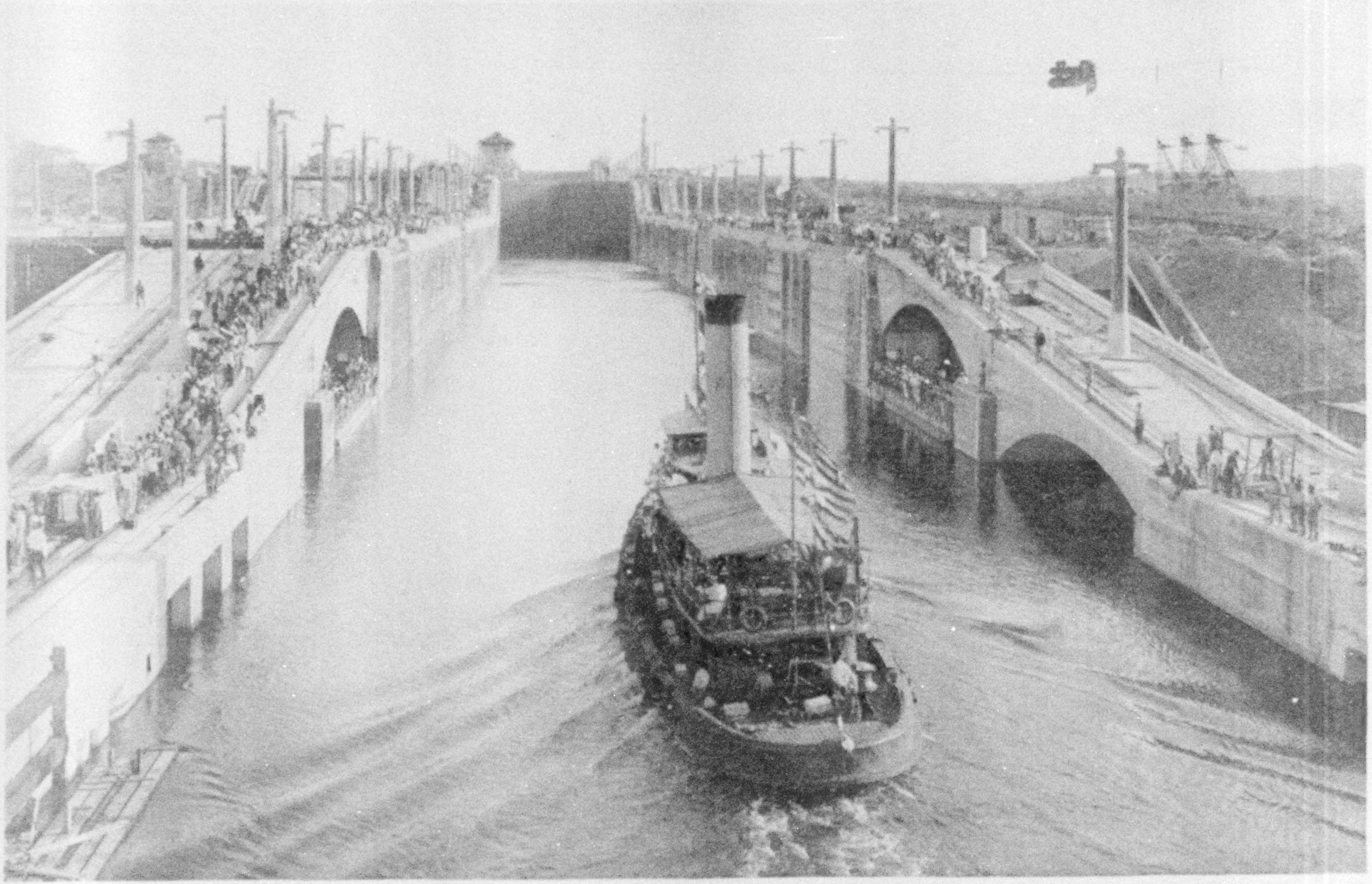
THE GATUN LOCKS, LOOKING TOWARD THE ATLANTIC

The waters of the Atlantic flow into the canal for seven miles, until they reach the first gates of the lower lock at Gatun. The lower and middle locks are shown in the picture, while the incline leading to the upper locks appears in the foreground. The swamps in the distance at the left were a constant source of trouble while the locks were being made, owing to the innumerable mosquitoes which bred in them (see page 159).



THE LOCKS AT GATUN, LOOKING IN THE OPPOSITE DIRECTION TOWARD GATUN LAKE

These are the upper locks at Gatun, where vessels lie during the last of the three stages of being lifted from sea-level, on the Atlantic side, to the level of the Gatun Lake, 85 feet above, after which there is 32 miles of clear sailing before Pedro Miguel, the first lock on the Pacific side, is reached. Beyond the locks we see Gatun Lake, 165 square miles in extent. Note the floating islands.



FIRST BOAT THROUGH THE GATUN LOCKS

One of the memorable days in the history of the Panama Canal was September 26, 1913, when the tugboat *Gatun* was lifted from sea-level to the surface of Gatun Lake, being the first boat to pass through any lock on the canal about ten vessels of various sorts in one lock chamber, and even then it was not full. Attention is especially called to one piece of plant in the fleet, and that is the old French dredge, a ladder dredge distinguished by the endless chain with buckets. This old French dredge has served loyally two administrations and is still in the advance guard going to attack Cucaracha slide. By a peculiar coincidence, M. Bunau Varilla, the former chief engineer of the French Canal Company, passed through the locks during this event aboard one of the boats in the fleet. He, as you know, was a great advocate of a sea-level canal.

More precautions have been taken probably in the Panama Canal locks than in any other locks in the world. In addition to having duplicate gates at each end of the lock, a great chain is attached to a system of hydraulic cylinders and kept in the position shown until a boat makes a landing alongside the guide wall and a towing locomotive takes charge of it. Then the chain is lowered into a groove in the bottom of the canal. This fender chain across the entrance is shown in the picture on page 168.

THE FLOATING ISLANDS OF GATUN LAKE

A large part of the bed of what is now Gatun Lake was formerly swamp land. In that swamp were logs on which grass and small trees had grown. When the lake rose, the entire bottom floated. The wind broke it into pieces, sometimes an acre or more in extent, and since that time these pieces have been floating aimlessly about the lake (see page 172).

During the fall of 1912 the water was allowed to flow 6 or 7 feet deep over the uncompleted spillway, and a large number of these floating islands were passed over it. As soon as the lake reaches normal height and water can be spared, these floating islands will be towed systematically to the spillway and passed over and out to the Atlantic.

As the waters of the Chagres River came down and encountered the dam at Gatun the lake was gradually formed, and during this process much vegetation was submerged. As the lake rose it gave the ladies of Panama great opportunities for collecting orchids.

The most beautiful orchids have a way of growing on the largest trees, and so high that they are difficult to get; but while the lake was rising to 85 feet above sea-level, one could row around in small boats through the trees and pick them off (see pages 174 and 175). A Kipling should have been at Panama to write a jungle story that would describe the action of the wild animals when this great permanent flood of the Chagres came.

The last natural barrier that held back the water of Gatun Lake from the cut that had been made across the Continental Divide was the dike at Gamboa. Up to this point the canal has followed the Chagres Valley. It now leaves the valley and cuts across the Continental Divide to Pedro Miguel, and there commences to go down the Pacific slope.

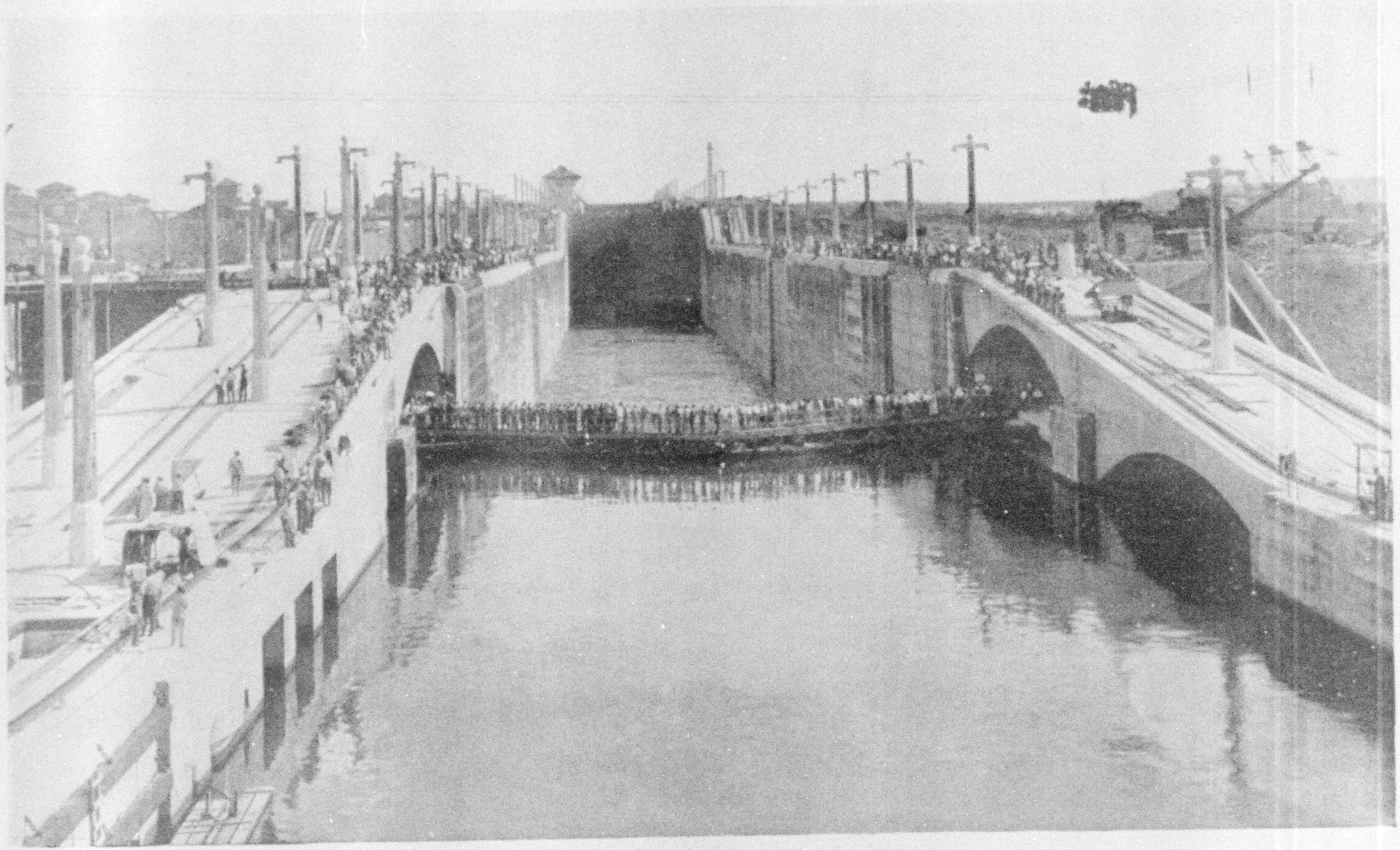
The Gamboa dike was broken down on October 10, 1913, by the explosion of a charge of dynamite which had been stored in it. This charge was fired by the depression of a telegraph key in the White House at Washington by President Wilson (see page 176). Before the dike was blown up, water was allowed to enter the Culebra Cut through pipes, so as to fill it to within 5 or 6 feet of the level of the lake. Had it been blown up with 30 feet difference in level, some damage might have resulted.

THE CULEBRA CUT AND THE SLIDES

The Culebra Cut will, it is thought, be the most striking of all the features of the canal. The Gatun Lake, when all the trees are gone, will be beautiful with its green islands and green promontories; but the most striking feature, I think, will always be the great cut across the Continental Divide.

The most difficult slides to handle have occurred in that part of the canal near the Continental Divide, marked by Gold Hill and Contractor's Hill, all comprised in a length of about 1½ miles of canal. Just beyond Gold Hill is the famous Cucaracha slide (see pages 147 and 151), the surface of which was above the lake level when the water entered Culebra Cut, and it prevented the water from flowing through the cut to Pedro Miguel.

An unsuccessful attempt was made on the same day that the dike at Gamboa



OPERATING THE GATUN LOCKS FOR THE FIRST TIME

The gate on which all the men are standing, while watching the lower chamber of the lock being filled for the first time, is the sea gate or guard gate (see page 159)

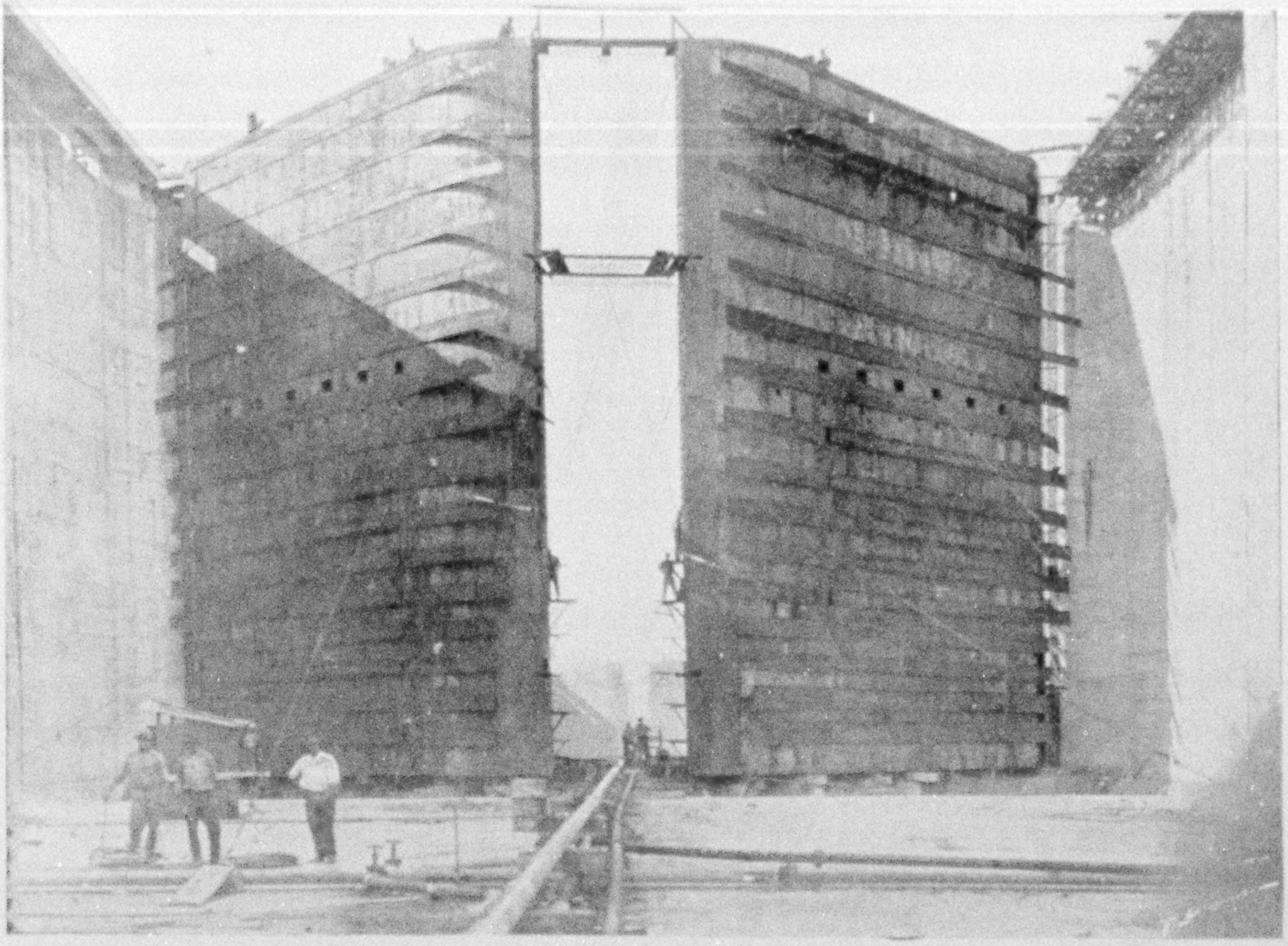


Photo and copyright by Edith H. Tracy

THE LOCK GATES

The lock gates are a most interesting feature of the canal. There are 46 of them, each having two leaves, and their total weight amounts to 58,000 tons. They vary in size from 47 to 82 feet in height and it takes no less than six million rivets to put them together. Some idea of their enormous size can be gained by comparing the men working on them with the gates themselves.

was destroyed to blast a channel through this slide. A ditch, however, was finally made across it, through which that part of the canal between Cucaracha and Pedro Miguel was filled with water. This allowed dredges to be towed from the Pacific end of the canal to assist those already brought from the Atlantic side in completing the channel excavations.

The Cucaracha slide has broken back to the crest of the hill behind Gold Hill, a half a mile or more from the prism. Since the slide is now broken back to the crest of the hill, and since the face of the hill away from the canal is being artificially removed, a fairly close calculation can now be made as to the number of cubic yards of material that can slide into the canal from that source and the approximate time that it will take to remove it.

A large part of the material composing this slide is clay, and it is hoped that it can be removed by pipe-line dredges. By placing a relay pump in the pipe-line, material can be forced over the banks of the canal. The pipe-line dredge is very efficient in digging and transporting material away from the site, providing the distance or lift is not too great. Material can be so transported from a half to three-quarters of a mile with great ease.

One of the dredges getting ready to attack the Cucaracha slide from the south is shown in the picture on page 148. This dredge came from the Pacific side, and across the slide can be seen the smokestack of the dredge that came from the Atlantic through the Gatun locks. It is hoped that within two or three months a channel can be made of sufficient width and depth for the passage of ships. How-

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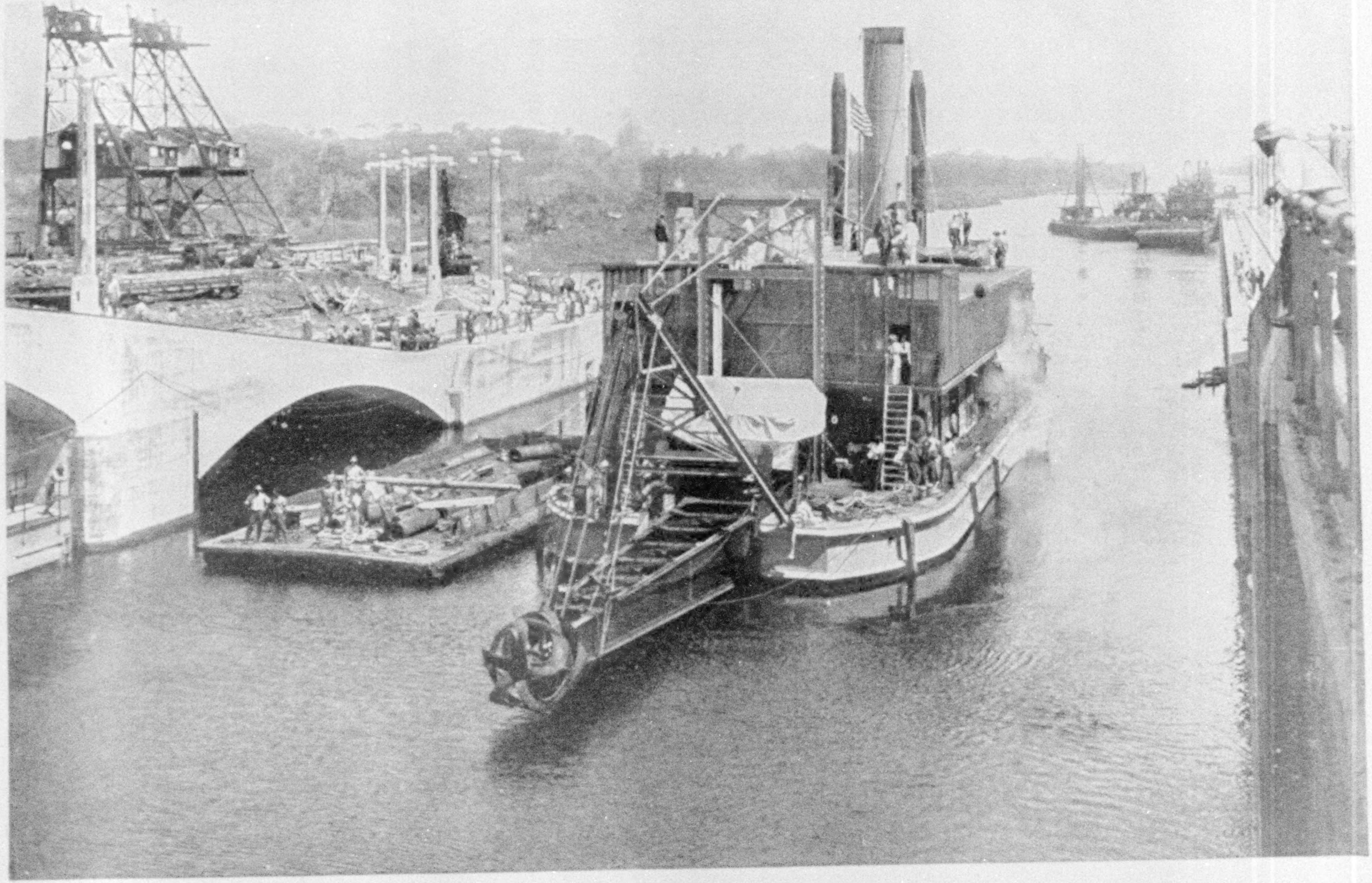
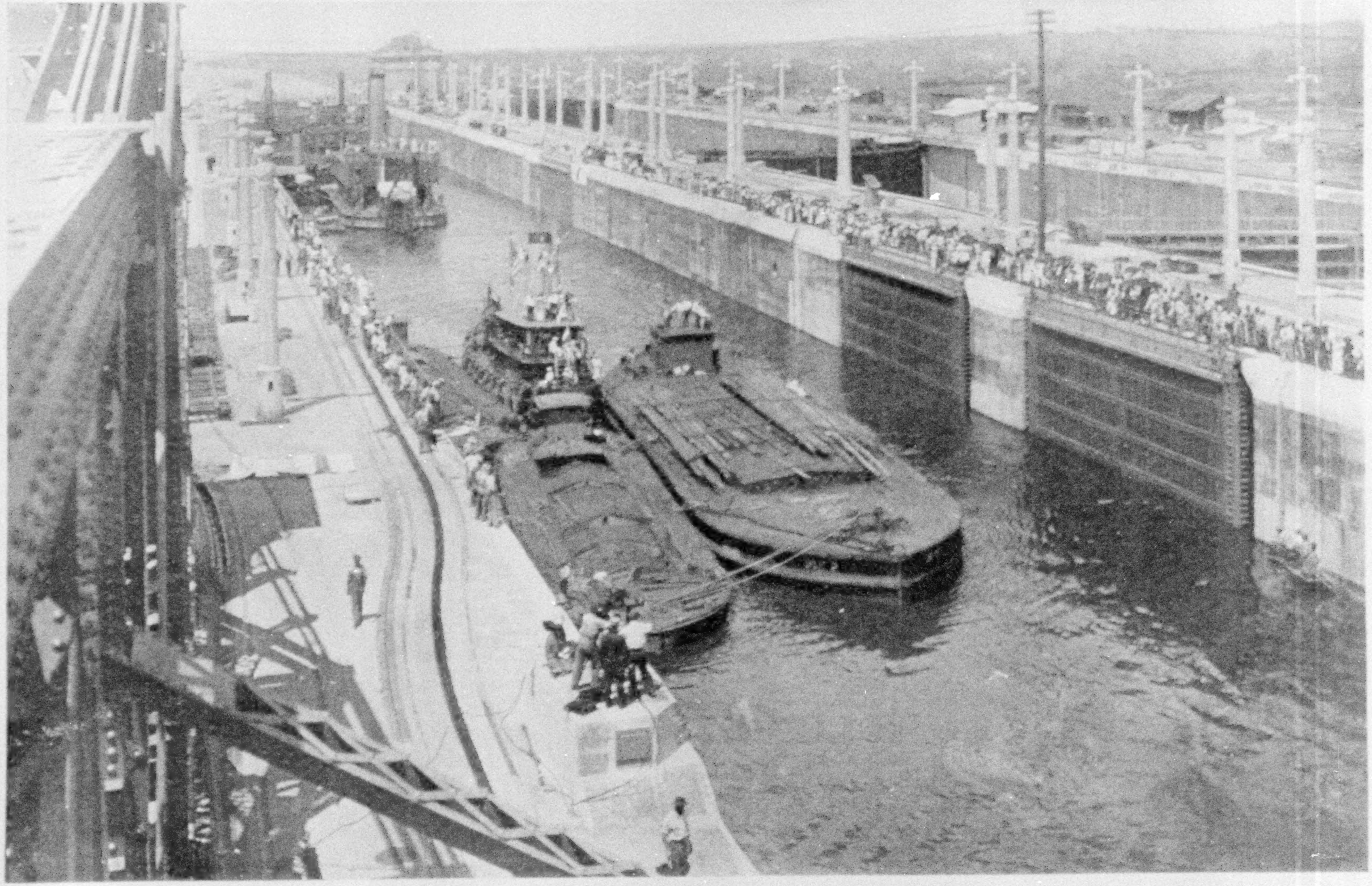


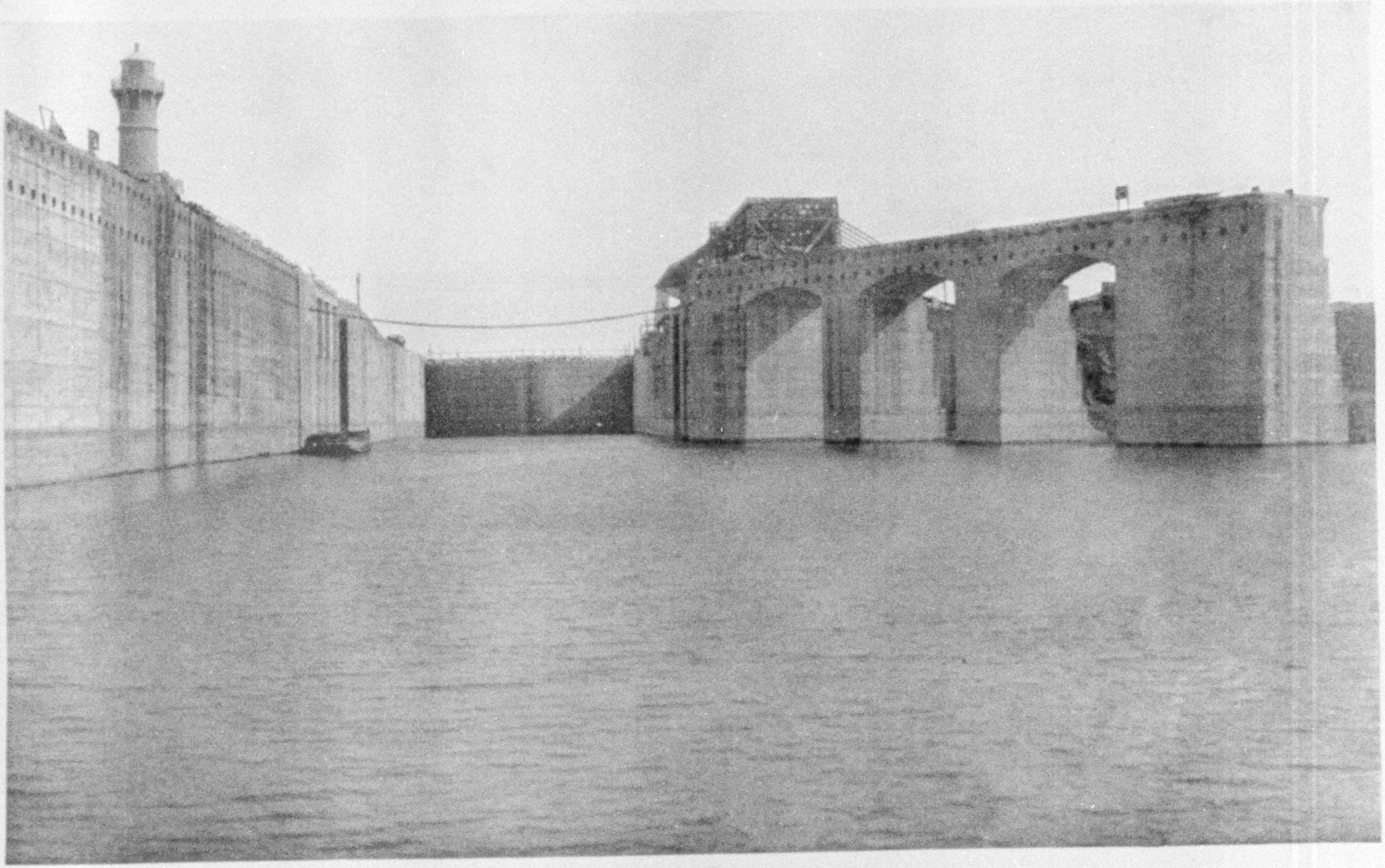
ONE OF THE GREAT SUCTION DREDGES ENTERING GATUN LOCKS

This is one of the great suction or pipe-line dredges, showing the cutter in front. When this cutter is revolved the blades loosen the dirt; the intake of the pump is just behind it, and when water is drawn in by the pump it carries in from 15 to 20 per cent of solid matter, and the pump gives it velocity enough to be carried from one-half to three-quarters of a mile through a pipe (see page 159).



DREDGING FLEET IN THE MIDDLE LOCK AT GATUN

The fleet is on its way to the Culebra Cut to help in removing the Cucaracha slide. The last dredge in the lock is an old French dredge of the ladder type, having an endless chain with buckets. This dredge has served loyally through two administrations and at the end was still in the advance guard. The immense size of the locks can be realized from the fact that there are ten vessels in this lock and yet it is not full.



ENTRANCE TO THE UPPER LOCKS AT GATUN, SHOWING THE GREAT GUARD CHAIN

"More precautions have been taken probably in the Panama Canal locks than in any other locks in the world. In addition to having duplicate gates at each end of the upper lock, a great chain is attached to a system of hydraulic cylinders and kept in the position shown until a boat makes a landing alongside the guide wall and a towing locomotive takes charge of it. Then the chain is lowered into a groove in the bottom of the canal" (see text, page 163).

ever, no one who has served on the canal would try to make a definite prediction. A picture of this slide before the water was let in is shown on page 146.

Gold Hill is a hard trap rock, with a volcanic neck extending down to an unknown depth, and is there to stay. On either side of it, however, the strata were very much disturbed and slides have occurred of all kinds of material, both clay and rock. The slides on the north side are nearly all of soft rock.

Colonel Gaillard, who had charge of the work in Culebra Cut, never knew, when he returned to work in the morning, that tracks and shovels would be found as left the night before. He struggled with the cut for six long years, until it was practically completed, but finally broke and died under the strain.

Two distinctive kinds of slides are encountered in Culebra Cut. In one case the entire body of material moves practically on an inclined plane, this plane being sometimes rock, sometimes clay. The Cucaracha slide is of this character and is called a true slide.

In slides of the other character, the first indication is a crack in the bank, sometimes 300 or 400 feet back from the edge of the cut. This crack or break opens, and the ground there will often settle down before it does at the edge of the cut. When the general movement comes, the bottom of the cut comes up. Steam shovels have been lifted by one of these slides as much as 18 feet, with the tracks hardly thrown out of alignment.

EARTHQUAKES AND THE CANAL

One of the great arguments against a lock canal at Panama was the earthquake argument, which prophesied that the locks would inevitably be destroyed by earthquake shocks. The picture shown on page 179 is the answer to that argument. It shows the famous flat arch in the now ruined church of Santo Domingo in Panama City, which has stood there for more than 200 years. The existence of this old and apparently unstable structure is a proof that Panama is free from serious earthquakes.

An examination of this arch, taken in connection with the fact that it has stood for the length of time it has, seems to warrant the conclusion that Panama has been more free from serious earthquakes during the time in question than Tennessee, Missouri, or Arkansas, when it is remembered that Reel Foot Lake, in Tennessee, and the "Sunk Lands," in Missouri and Arkansas, along the basin of St. Francis, were formed during an earthquake in 1812, a little more than a century ago, while this structure has stood for more than twice that period.

Panama has been visited by a few earthquake tremors lately, one of them being of sufficient intensity to cause vases to fall from shelves, but careful examination of the locks failed to show the slightest cracks in the masonry, and the dam showed no tendency to settle or change its form in any way whatever. The center of the disturbances which produce the tremors is usually about 200 or 300 miles away. I do not know where the center of these last disturbances was, but when the serious earthquakes occurred in Costa Rica two or three years ago, only slight tremors were felt at Panama.

While I was away, in November, my wife wrote me that there had been another little earthquake since I left. She was upstairs and had a Jamaican woman sewing at the time, and just as the house commenced to shake the Jamaican woman fell down on her knees to pray. While my wife believes in the efficacy of prayer, she told the woman that the best place to pray during an earthquake was outside. The advice is thought to be good.

THE GATUN LOCKS

All the essential features of the Gatun locks are situated on rock. It is a soft rock and was called indurated clay in the first description of it; but people did not understand what indurated clay meant, and so the name was changed to argillaceous sandstone.

This stone is solid and makes a good foundation when not exposed to the air. If so exposed, however, it acts like shale and goes to pieces. In making an excavation for the locks and as soon as grade was reached, the foundation was immediately covered with concrete, thus re-

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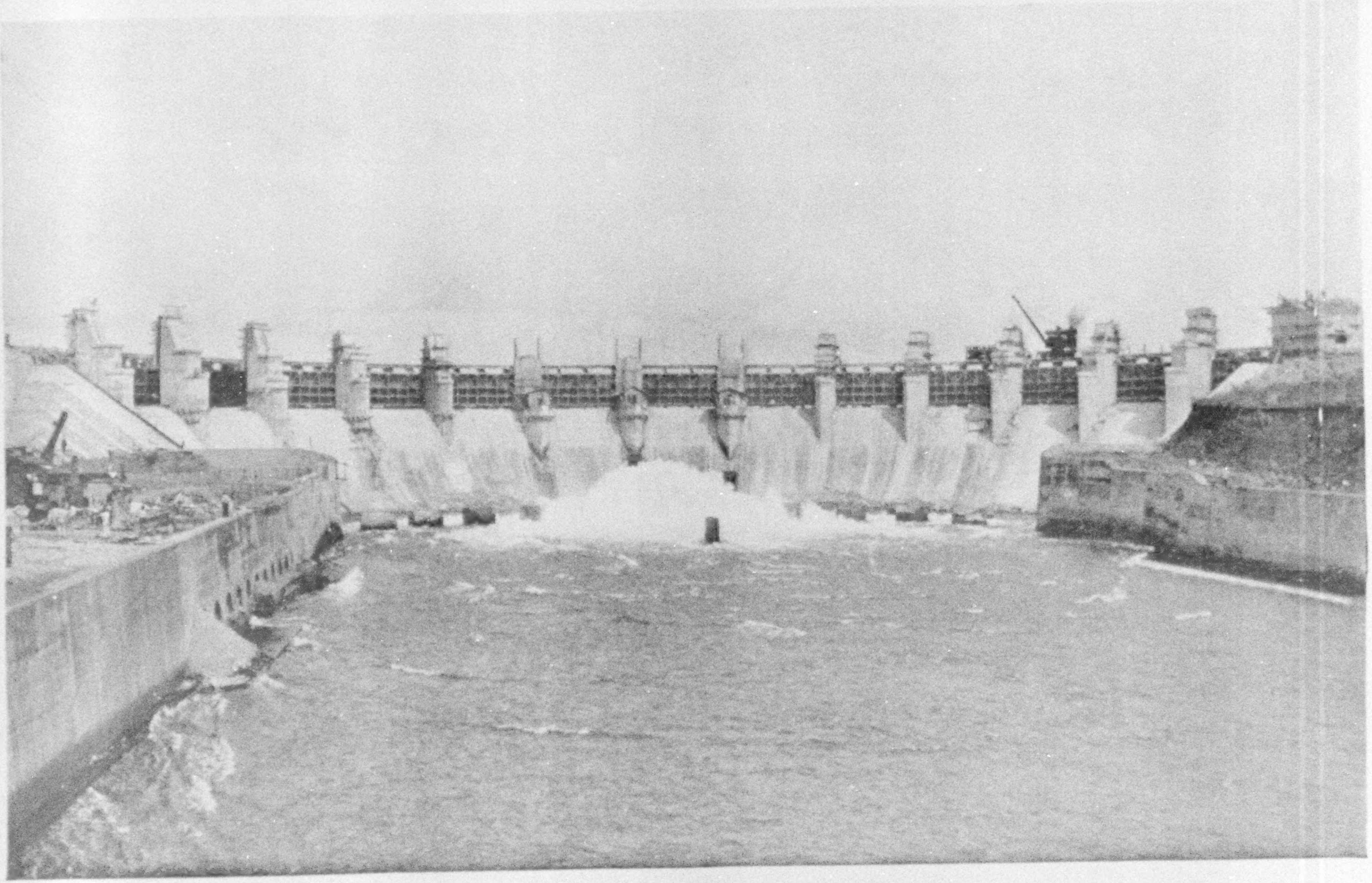
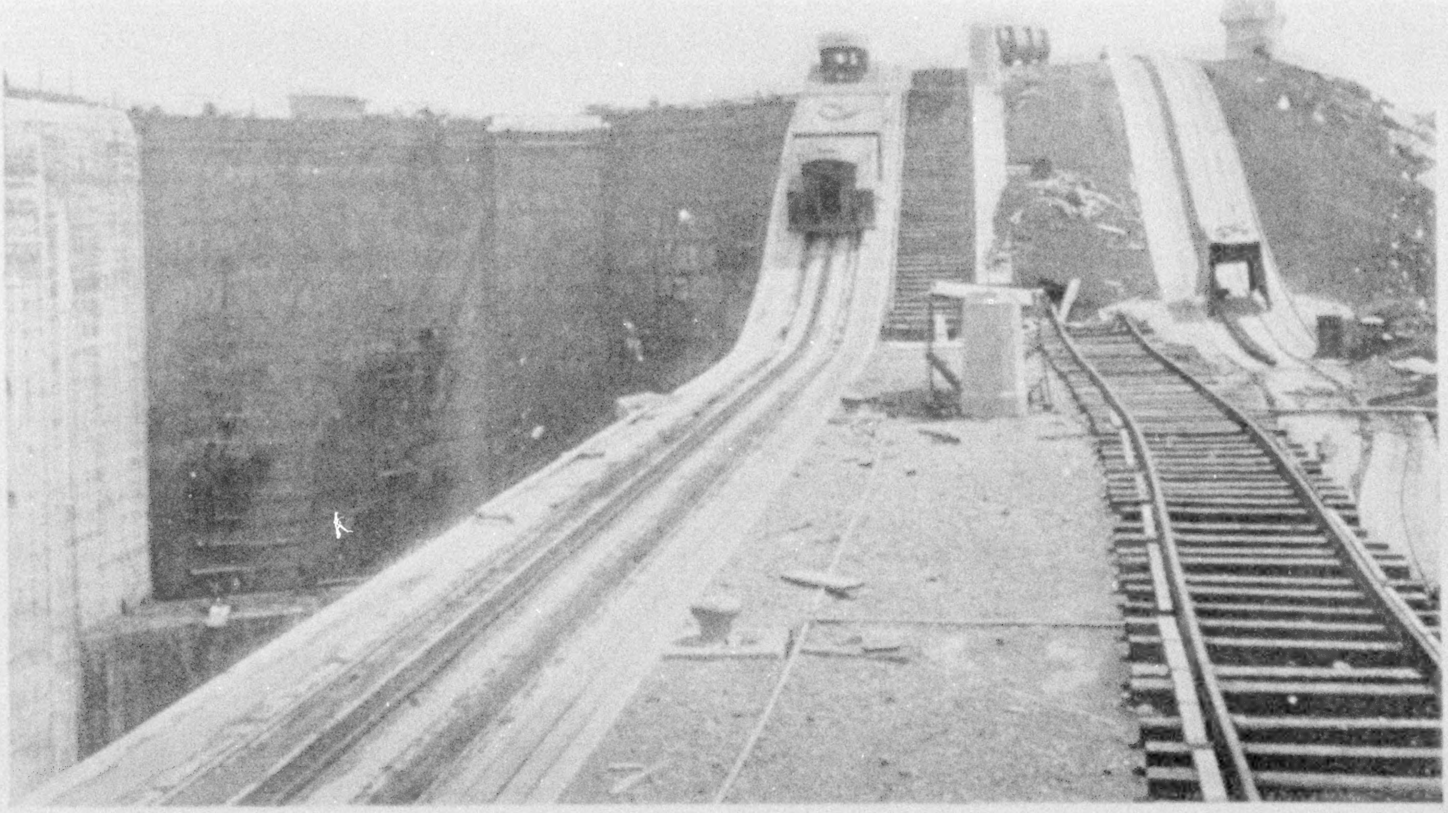


THE SAFETY VALVE FOR THE CHAGRES RIVER AND GATUN LAKE: THE GATUN SPILLWAY

The surplus waters of the Gatun Lake escape to the Atlantic Ocean through this spillway. It is a large semicircular concrete dam, along the top of which are 13 piers, which furnish it with 14 outlets. These outlets are closed by huge steel gates, 45 feet wide and 20 feet high, each weighing 42 tons. Should the Chagres River fill Gatun Lake so full of water as to endanger the locks at Gatun, this spillway would act as the safety valve. Even if the lake rose to the improbable height of 92 feet above sea-level—its normal height is 85 feet—it would not be necessary to open all the gates on the spillway. Three or four of them would carry off all the water necessary to avert danger.



THE LOCOMOTIVES OF THE LOCK

These little electric locomotives, here shown climbing the incline between the middle and upper locks at Gatun, are very powerful and will be used to draw the big ships through the locks. No ship will be allowed to go through the locks under its own steam (see page 173). Note the men at work on the huge lock gates.

producing the same condition under which nature has kept the rock sound.

There can be no question as to excellence of the foundation of the locks at Gatun. They are completed and have been subjected to the most trying conditions without the slightest settlement or crack. As stated before, all the essential parts are on rocks; the only exception is the south guide wall, the one that leads into Gatun Lake. This is built on piles and is of as light construction as possible. It has no particular function except that ships will land on both sides of it.

Prior to the construction of the Gatun locks, many holes were made with a diamond-drill outfit into the rock foundation to depths of 100 feet or more below sea-level in order to ascertain the character of the foundation and determine whether or not the rock was sufficiently creviced to transmit pressure from the lake to the lock floor. After the holes were bored the ground water showed in them. By pumping the water out of some of the holes and observing to what extent and how quickly the water was lowered in the others, conclusions were drawn as to the probability of the rock being sufficiently creviced to transmit pressure.

These experiments indicated that minute crevices were in the rock, not enough for the passage of any appreciable amount of water, but probably enough to transmit pressure. Consequently the floors in the Gatun locks from the emergency dams to the intermediate gates of the upper locks are so built that if the full lake pressure does come under them they will stand it. Below that, provision is made for carrying any leakage to sea-level through drains behind the lock walls.

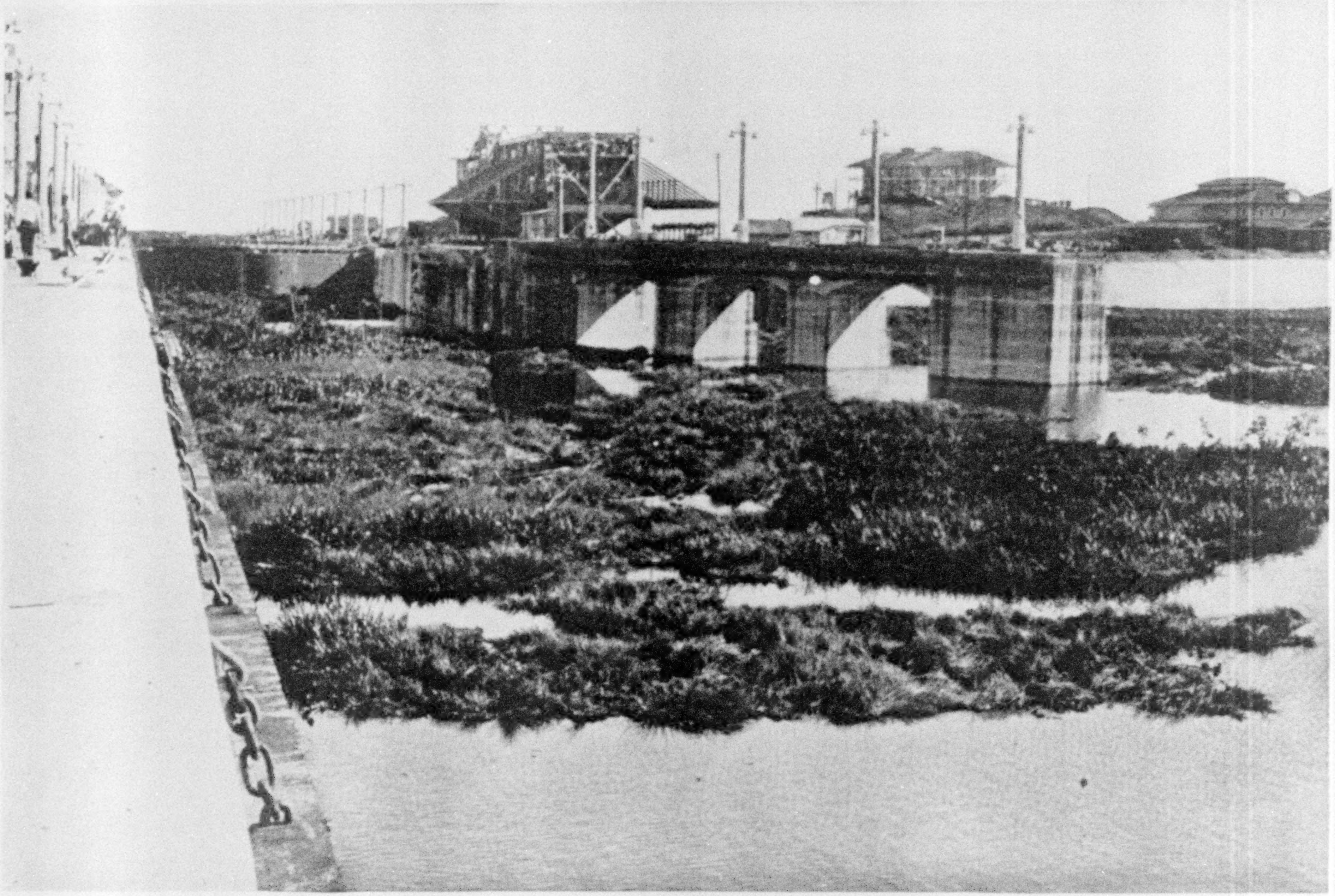


Photo and copyright by Underwood & Underwood

FLOATING ISLANDS OBSTRUCTING THE LOCK

A large part of Gatun Lake bed was swamp land. In that swamp were logs on which grass and small trees had grown. When the lake rose the entire bottom floated. The wind broke it into pieces, sometimes an acre or more in extent, and since that time these pieces have been floating aimlessly about the lake.

In case a ship should break the upper lock gates and the Gatun Lake should start to flow through the flight of locks to the sea, a swing bridge is provided for each upper lock, by means of which an emergency dam can be built across the locks. The operation of these swing-bridge dams is as follows: The bridge is first swung across the lock chamber and heavy girders are then lowered, one end of each of them finally resting against a sill previously built in the bottom of the lock entrance. Steel curtains are then run down in tiers on tracks on the girders, gradually building a dam and stopping the flow of water. The girders and curtains are all lowered under power and the entire operation can be carried on through swiftly flowing water.

It is purposed to allow no ship to go through the locks of the Panama Canal under its own steam. A ship will be required to land alongside the guide wall at either end of the locks.

Towing locomotives, four of them, will run down the guide walls, pass lines to the ship, two forward and two aft, and will then tow the ship into the locks, hold it during the time it is being raised or lowered, and finally deliver it alongside the guide wall at the other end. This is a precaution that has never been taken before in operating locks. One of the experimental towing locomotives is shown in the picture on page 171.

Ships are ordinarily allowed to pass through locks under their own steam. The wrong ringing of a bell or the misunderstanding of a bell has ordinarily been the cause of wrecking a lock gate.

HIGH AND DRY BELOW SEA-LEVEL

One of the most difficult problems at Gatun was the preparation of a foundation at the lower end of the locks. It was necessary to go 70 feet below sea-level through soft mud to find rock suitable for foundations. The material was so soft that steam shovels could not be supported on it, so it was decided to do the excavation by dredges. A sufficient width of land between the space to be excavated and the canal toward the Atlantic was left to act as a dam when the excavation was finally completed and unwatered.

A dredge was allowed to cut a narrow channel through this dam into the space where the walls were to be built. This dredge dug the entire space to a depth 40 feet below sea-level, which was its limit. A dam was then placed across the narrow entrance cut, with the result that the dredge lowered itself as it continued its work. When it had lowered itself to 30 feet below sea-level, it could excavate to the required depth—70 feet below sea-level.

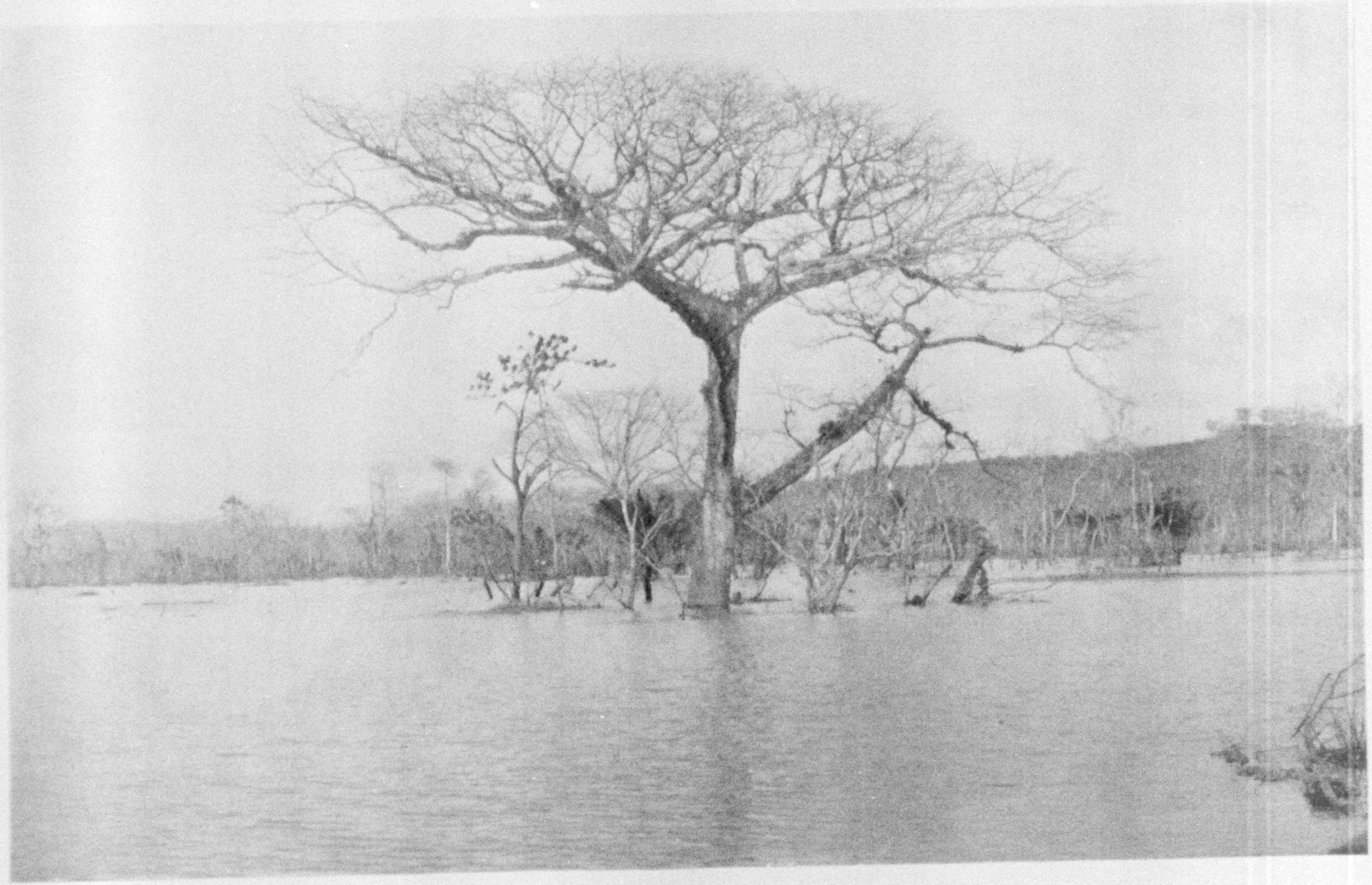
After completing the excavation, the dredge pumped all the water out of the space, leaving itself grounded 55 feet below the level of the sea, in which position it remained until the walls were completed. Water was then let in from the sea; the dredge floated and cut its way out (see page 179).

THE GREAT GATUN DAM

Gatun dam, across the Chagres Valley, is about a mile and a half long, a third of a mile thick at the base, with a top elevation of 105 feet above sea-level. A small hill existed in the center of the valley at the dam site. While it was 200 feet below sea-level to rock in the portion of the valley to the east of the central hill and 260 feet to rock in that portion to the west, rock was found at 40 feet above sea-level in the central hill itself—a fortunate condition, because a stable channel for the temporary diversion of the Chagres could be easily cut through this hill, across which channel a masonry spillway, founded on rock, could be built later.

A spillway through an earthen dam is generally looked upon with disfavor. While the Gatun Dam is earthen, it is really two dams, one extending from the locks to this central hill and one from this central hill to the west side of the valley. Rock existing at a high elevation in this central hill made it an ideal location for a spillway or waste weir.

When the building of the Gatun Dam was commenced, the Chagres River was flowing through three channels at the dam site—its own, the old French canal, and a diversion channel dug by the French to the west of Spillway Hill. The first operation was to block the flow of



THE DYING JUNGLE IN GATUN LAKE

"As this lake rose it gave the ladies great opportunities for collecting orchids. The most beautiful orchids have a way of growing on the largest trees and so high that they are difficult to get, but as the lake rose to 85 feet above sea-level, one could row around in small boats through the trees and pick them off" (see text, page 163). When this photograph was taken the water had only risen to 52½ feet above sea-level.

THE DROWNING TREES IN GATUN LAKE

When this picture was taken there was only 52½ feet of water in Gatun Lake, but when the lake is full these trees will be entirely submerged

the Chagres through its own channel and through the old French canal, thus forcing all the water through the west diversion channel.

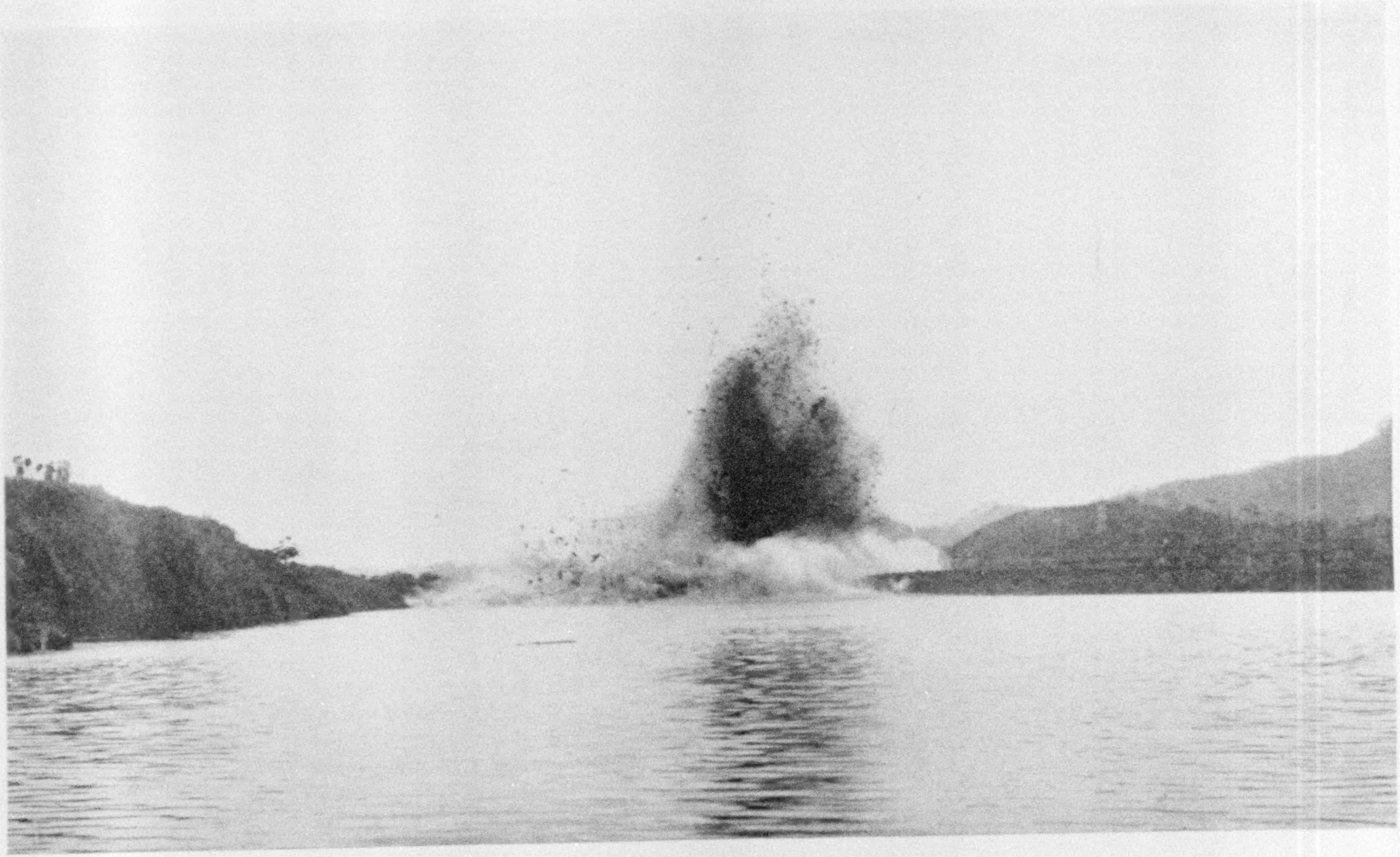
This enabled the work of building the east half of the dam to be started while a channel was being dug through the Spillway Hill. As soon as this latter channel was finished the Chagres River was turned into it by damming the west diversion channel.

The bed of the west diversion channel being below sea-level, with soft banks and bottom, and the bottom of the Spillway channel being 10 feet above sea-level, this last diversion of the Chagres proved to be a troublesome undertaking. As soon as this last diversion was accomplished work on the west half of the dam was commenced.

The watertightness of the Gatun Dam was never a subject of serious apprehension. The material under it and that in the center of it are practically impermeable. The great problem concerning the Gatun Dam has been to make the material on which it was built carry the load.

I referred to the rock being 200 feet below sea-level on one side of Spillway Hill and 260 feet on the other. These old gorges, so the geologists say, were made by the Chagres River when all the country in the vicinity of Gatun was about 300 feet higher than it is now. When the site of the Gatun Dam was lowered 300 feet during some early volcanic disturbance and its old beds lowered 200 feet below sea-level, the sea backed up the Chagres Valley and in time filled these old gorges with deposits, largely of clay, which in some places were soft. In order to make such a foundation carry a heavy load, an exceedingly broad base was necessary.

Dams are ordinarily built with quite steep slopes, one in two, or one in three,



BLOWING UP THE GAMBOA DIKE (SEE PAGE 163)

The last land barrier between the two oceans was broken down on October 10, 1913, by the explosion of a charge of dynamite stored in the Gamboa Dike. The charge was fired by the depression of a telegraph key at the White House by President Wilson whereas the Gatun Dam was built with a slope of about one in ten. The foundation was simply spread, making the dam about a third of a mile through at the base, so that the underlying material would carry the load. This underlying material was compressed under the load in some places as much as 15 feet. As the load was gradually placed on it, the material in the base became more and more compact, until finally settlement has practically ceased.

Every two or three months borings have been made through the material in the dam itself, and that under it, for the purpose of ascertaining any changes in the character of such materials. This data shows that the material, both in the dam and under it, is continually becoming more compact. It stands today, safely carrying its full load, and tomorrow it will be able to carry more.

THE JAMAICAN IS HARD TO KILL

The dam was built by constructing trestles in both edges of it and from these trestles making rock fills or "toes." When these toes had reached a height of 60 feet on the south face and about 30 feet on the north, dredges commenced to pump an impermeable mixture of sand and clay in between them. This central core constitutes the real barrier to the passage of water through the Gatun Dam.

As the hydraulic fill was built up the rock fills were carried up, so as always to constitute levees, holding the additional hydraulic fill. A pipe-line dredge pumps about 20 per cent solid material and 80 per cent water, so in building a dam in this way it is necessary to provide some means for draining off the surplus water.

This was done where the dam joins the hill, a 20-inch pipe being laid in a trench on the rock and carried in to the lower edge of the hydraulic fill. An elbow was then placed on the end of the pipe, and as the water and hydraulic fill rose other sections were added to the elbow. A cage was placed around the intake end of this pipe to keep the drift away, and men were sent occasionally to remove such drift from the pipe intake.

At one time when water was running through this pipe under a 30-foot head, three Jamaicans were removing drift and one of them fell in the 20-inch pipe. The other two tried to pull him out but could not. They let him go and ran as quickly as they could to the other end of the pipe. The man traveling in the pipe reached the end first, notwithstanding the fact that he turned a corner at an angle of 90 degrees. His ears were scratched a little!

There was a great deal of emulation between the employees in the different divisions. The part of the story so far told is true, but Colonel Gorgas made the addition that the man jumped up and said that there wasn't anybody on the Pacific Division who could do that.

The spillway over which the surplus waters of the Gatun Lake find their way to the Atlantic Ocean is found on page 170. This is a picture of the spillway when practically complete.

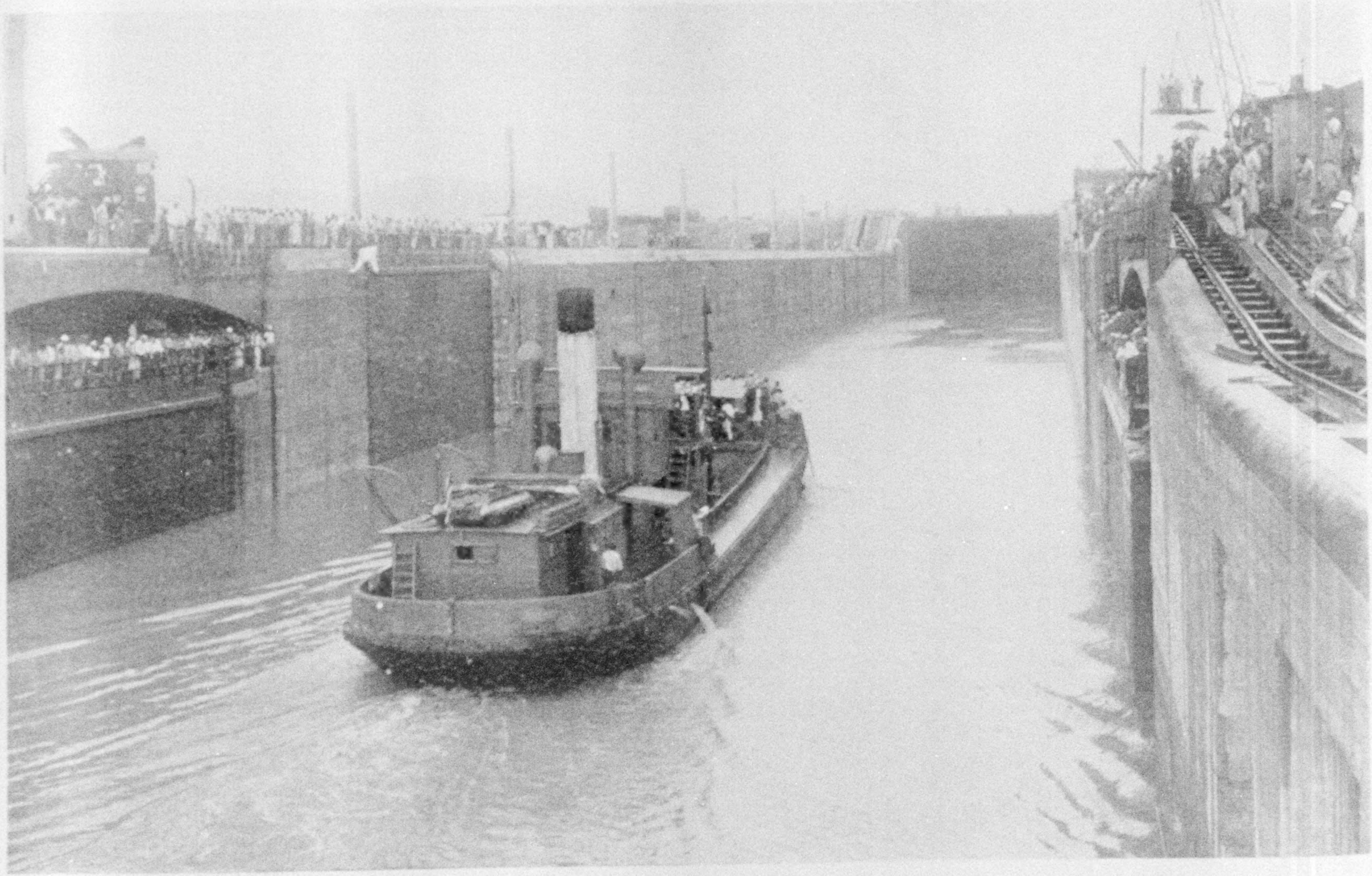
The gates on top are 45 feet wide and the lake will stand 16 feet deep against them when no water is being wasted; consequently if one or more of the gates is lifted water will flow between the piers 16 feet deep. These gates are raised and lowered like a window-sash. These movable gates constitute the regulating works, by means of which the level of Gatun Lake is controlled.

"THE QUEEN OF AMERICA" AND THE LUNCHEON PARTY

In the beginning but very little provision was made for quarters for families of the canal employees. It soon became evident that order could not be maintained, contentment prevail, and a permanent force kept unless the wives of the men were there; so the commission undertook to build family quarters.

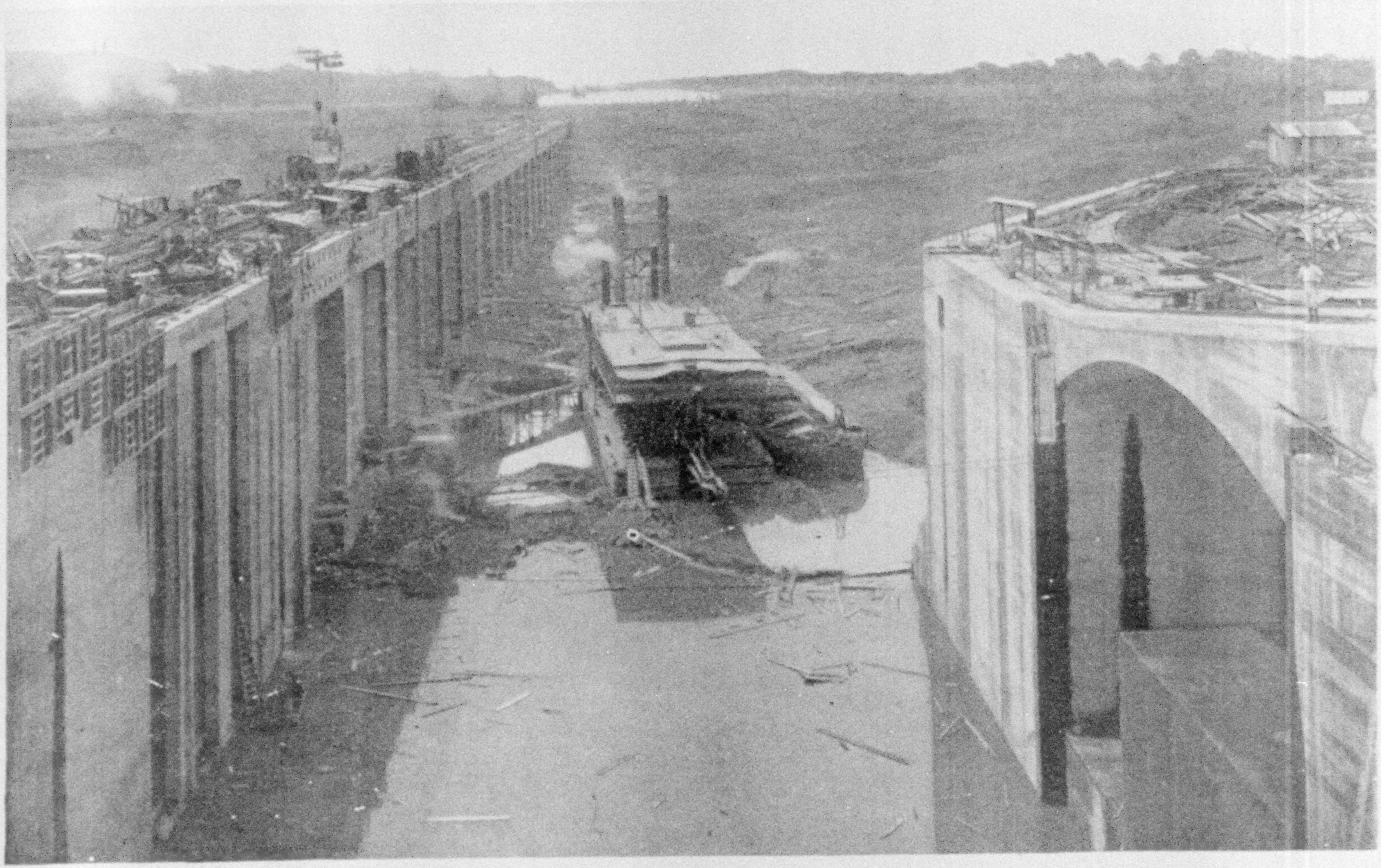
It was announced in circulars, etc., that employees would be provided with family quarters within ten months after arrival on the Isthmus. Not only all the married men immediately applied for quarters, but nearly every unmarried man on the job applied. Family quarters carried with it free light and fuel.

Nearly every one of the young unmarried men the first time they came back from leave brought a wife if they could get one. The building department was



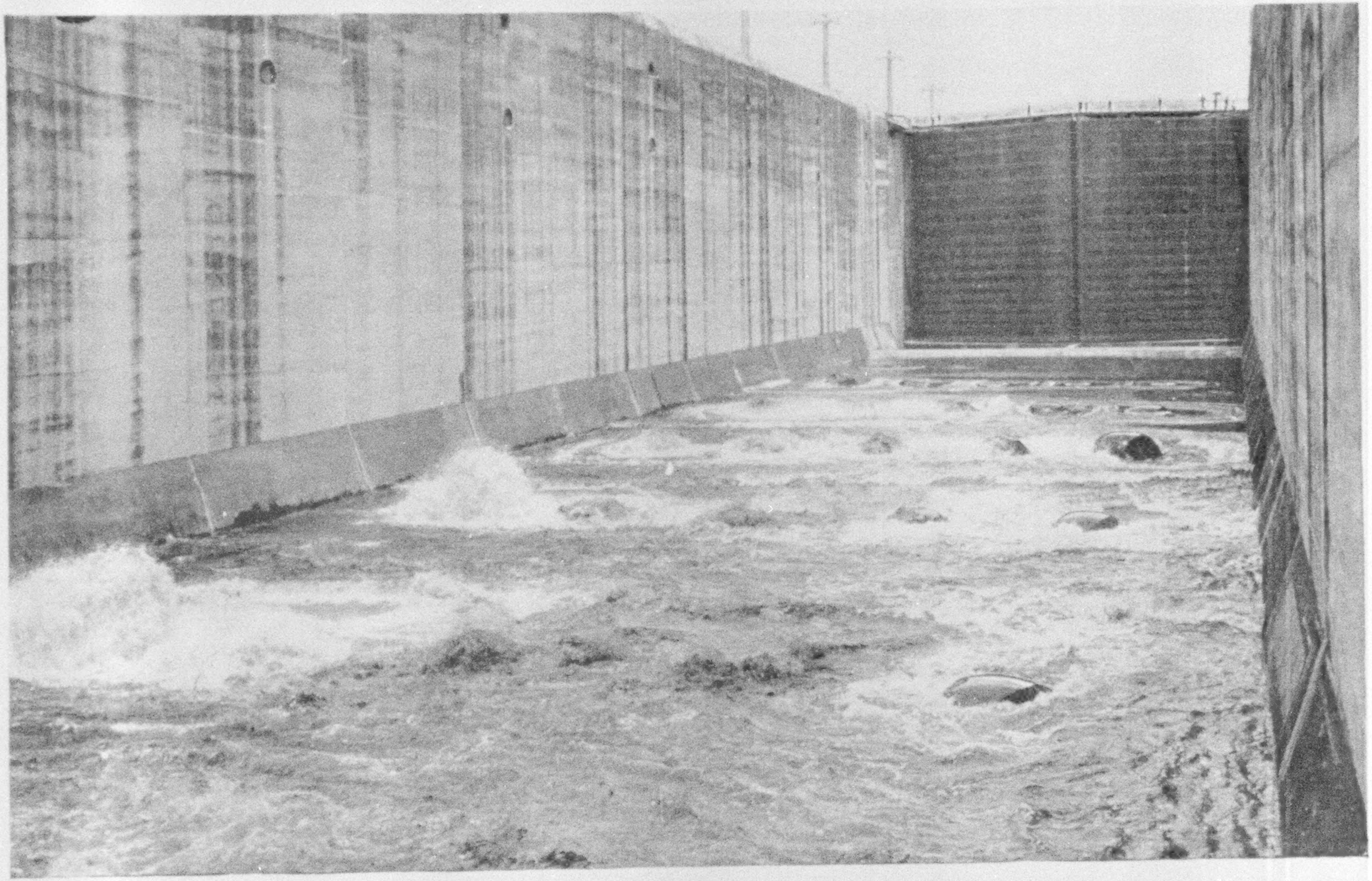
THE FIRST BOAT THROUGH MIRAFLORES LOCK

The lock-chambers here and at Pedro Miguel are the same size as those at Gatun. At this lock, the last on the Pacific side, boats can be let down to the level of the Pacific from that of the Miraflores Lake, through which the canal runs after leaving the Pedro Miguel locks at the termination of the Culebra Cut. The boat shown in the picture is entering the lock from the Pacific Ocean.



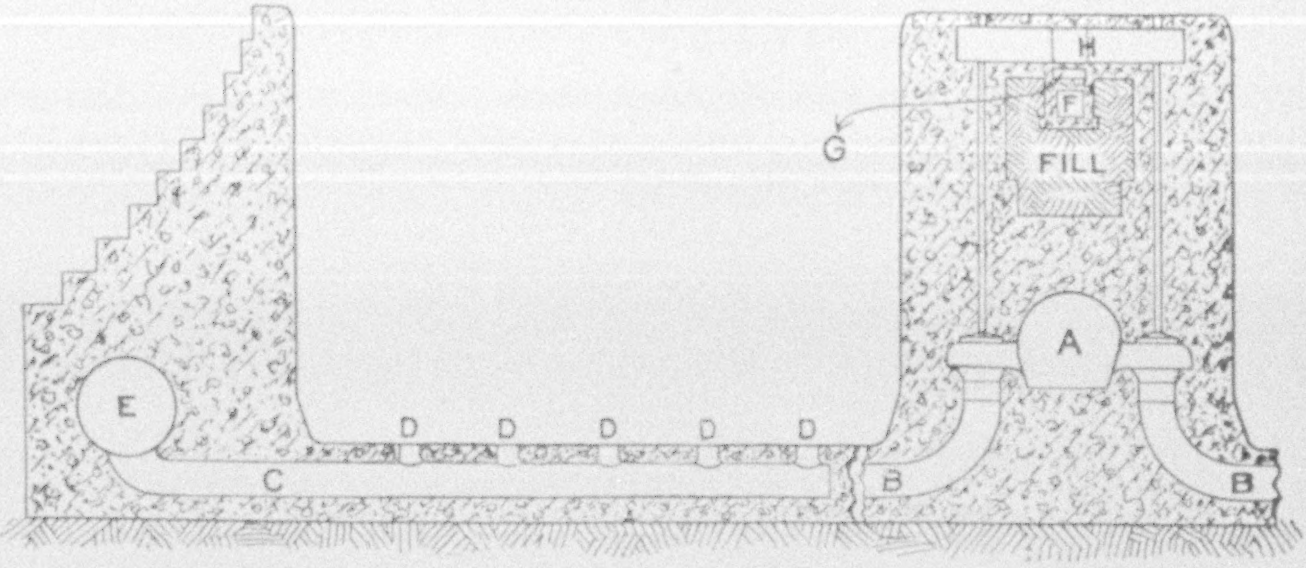
DREDGE GROUNDED 55 FEET BELOW SEA-LEVEL (SEE PAGE 173)

This dredge was used to excavate the foundations of the Gatun lock and dug down 70 feet below sea-level. "After completing the excavation, the dredge pumped all the water out of the space, leaving itself grounded 55 feet below the level of the sea, in which position it remained until the walls were completed. Water was then let in from the sea; the dredge floated and cut its way out."



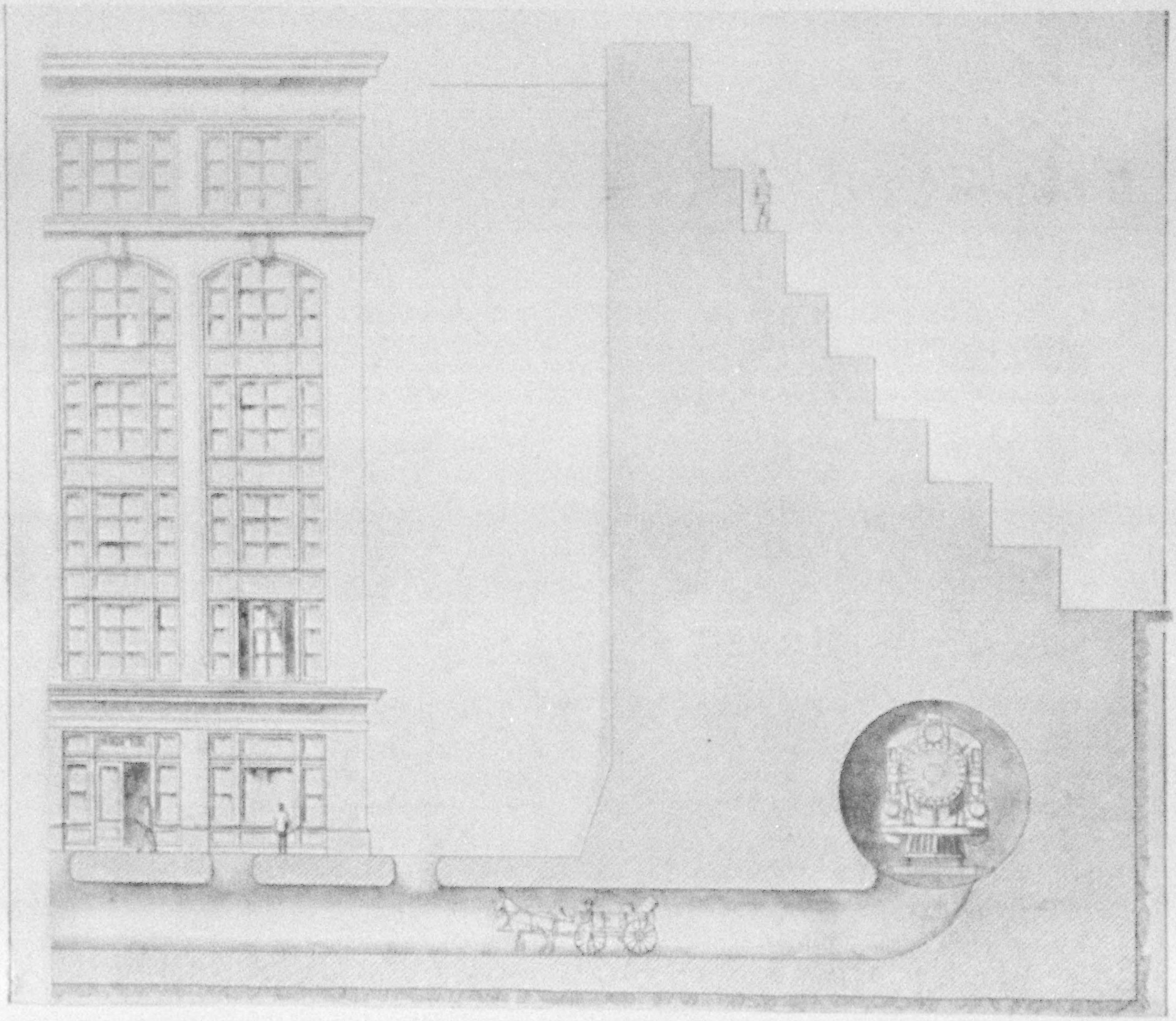
FILLING A LOCK

The water enters through a series of apertures arranged in rows of five along the floor of the lock. The barrel-shaped objects on the right of the picture are jets of water which have not burst into spray like those on the left (see page 181)



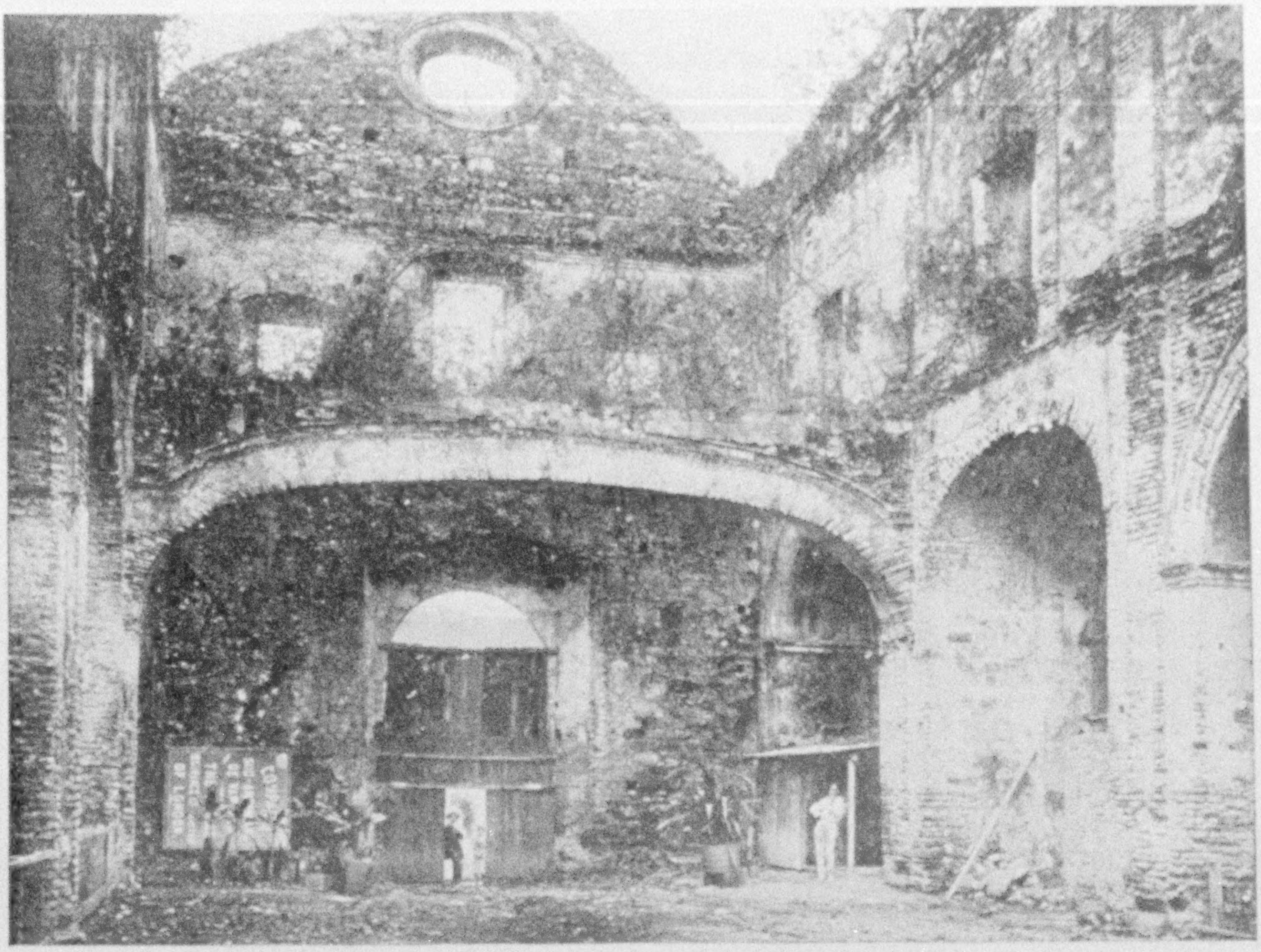
A CROSS-SECTION OF A LOCK CHAMBER AND WALLS, GATUN LOCKS, SHOWING HOW THE LOCKS ARE FILLED AND EMPTIED

A. Culvert in center wall.
B. Connections between center and lateral culvert.
C. Lateral culvert.
D. Wells opening from lateral culverts into lock chamber.
E. Culvert in side wall.
F. Drainage gallery.
G. Gallery for electric wires.
H. Passageway for operators.



THE SIDE WALL OF ONE OF THE GATUN LOCKS COMPARED TO A SIX-STORY BUILDING

The size of the culverts may be appreciated from the engine and dray. The "steps" have been filled in with earth and stone and graded to the top



THE FLAT ARCH AT PANAMA

One argument against the construction of a lock canal was that the great locks at Panama might be destroyed by earthquakes. This flat arch, which any serious earthquake shock would destroy, has stood for nearly three centuries in the now ruined church of Santo Domingo at Panama, proving that fear of earthquakes is groundless (see page 169).

consequently overwhelmed and the commission was forced to withdraw its literature and make no promises. An attempt was made after that to provide a certain percentage of the employees with family quarters.

The greater part of the laborers on the canal were Jamaican negroes. They were British subjects, but were ordinarily called "British objects." They make good servants if thoroughly trained and the routine is not varied.

To illustrate the effect of varying the routine: Visitors often came rather unexpectedly for lunch at Gatun, and in order that things might go right if my wife happened to be away when company came, she had prepared menus for lunches—number 1, number 2, number 3, etc. All I had to do was to telephone the cook that so many people were coming and to prepare lunch number so and so.

One day Mrs. Roosevelt and her daughter came with Mr. Bishop to see the work at Gatun, and after asking them to lunch, my wife being away, I telephoned the cook that there would be three extra people and to prepare luncheon number 1. I, unfortunately, said that Mrs. Roosevelt would be there.

The Jamaican has great respect for royalty. Before reaching home I heard that our servants had passed the word around among the other servants at Gatun that the Queen of America would take lunch at our house today. On entering the house it was evident that every piece of cut glass, silver, or pretty China in the place was out where it could be most easily seen.

On reaching the table it was soon seen that we had lunches 1, 2, and 3 combined. But finally, when four tiny cups of coffee were passed on a large salver resurrected

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from an old chest upstairs, the ridiculous side of the situation was complete.

Now that the canal is essentially finished, what are the American people going to do with it? Shall the new markets brought into existence on the Pacific shores of Central and South America by this new cheap transportation route be supplied by the United States or by foreign countries?

In my judgment, that depends, more than anything else, upon whether the Congress of the United States enacts such laws as will bring into existence a United States merchant marine engaged in foreign commerce.

THE NATION'S UNDEVELOPED RESOURCES

BY FRANKLIN K. LANE

SECRETARY OF THE INTERIOR

The following article gives such a constructive and national presentation and discussion of our country's undeveloped resources that it should be read by every American. It forms the annual report to the President of the United States by Mr. Lane, Secretary of the Interior, and is here published in full. For a map of Alaska, see the Supplement to this number of the NATIONAL GEOGRAPHIC MAGAZINE.

THERE exists a feeling in the West that its affairs and needs have not been given that consideration at the hands of the national government which they merit. This feeling is not confined to speculators or exploiters. It is the sentiment of many who are without selfish motive and regard the matter wholly from the standpoint of national growth. They point to the conditions which obtain in Alaska as unparalleled among people of our aggressive and nation-building stock.

So, too, they are unable to understand why ways have not been found by which the great bodies of coal and oil lands, of phosphate and potash lands, may be developed, and the waters of the mountains made available for the generation of power and the redemption of the desert.

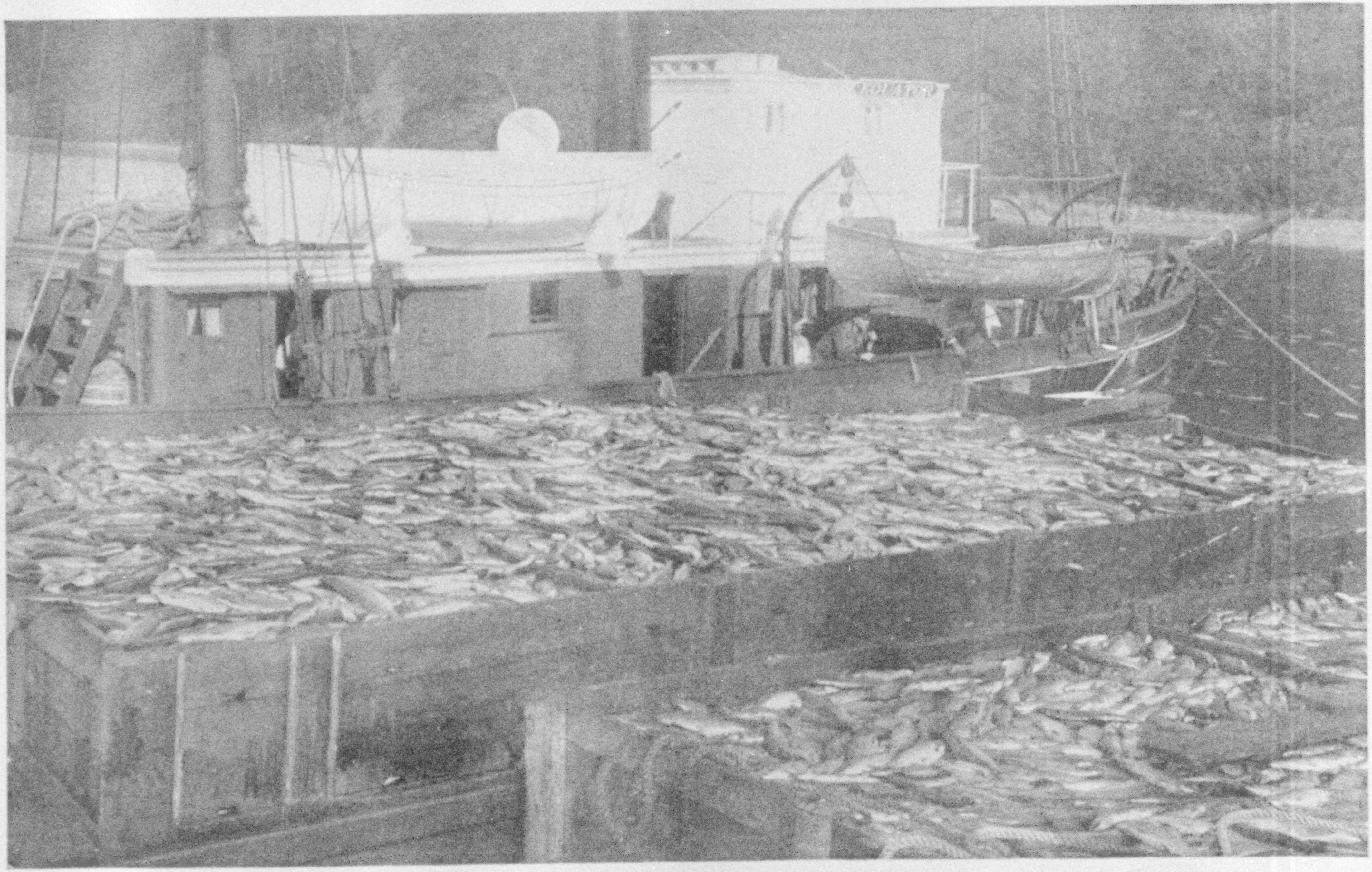
There is one very simple explanation for the existence of this feeling. We have adventured upon a new policy of administering our affairs and have not developed adequate machinery. We have called a halt on methods of spoliation which existed, to the great benefit of many, but we have failed to substitute methods, sane, healthful, and progressive, by which the normal enterprise of an ambitious people can make full use of their own resources. We abruptly closed opportunities to the monopolist, but did not open them to the developer.

FORMERLY WE TRIED TO GET RID OF OUR LAND AS QUICKLY AS POSSIBLE

I have said that we had put into force a new land policy, which caused dismay and discontent. Let me explain what I mean by this. It was, in fact, but a new application of an old policy. Congress has always been most generous as to the disposition of the national lands. One cannot read our land laws without being struck with the fixed determination which they show that it was wisest to be quit of our lands as quickly as possible. It might almost be said that the government regarded its lands as a burden rather than an asset. We gave generously to our railroads and to the States. There was land for all, and it was the government's glad function to distribute it and let those profit who could.

There was no thought then of creating timber barons or cattle kings, or of coal monopoly. The sooner the land got into hands other than those of the government the better.

And this generous donor was not so petty as to discriminate between kinds of lands, the uses to which they could be put, or the purposes which those might



CARGOES OF SALMON ARRIVING AT AN ALASKAN CANNERY

"The purchase of Alaska was made as a means of protection against the possible aggression of a foreign nation and without the hope that it would be even self-supporting. In the intervening 46 years we have given it little more than the most casual concern, yet its mines, fisheries, and furs alone have added to our wealth the grand sum of $500,000,000" (see text, page 185).

have who got them. Land is land, save when it contains minerals; this was roughly the broad principle adopted. To classify was a task too difficult or not worth while. The lands would classify themselves when they arrived in individual ownership. And so the door was opened for monopoly and for fraud.

If the government did not appreciate the invaluable nature of its assets, there were men who did. Great fortunes were laid in the vast holdings of what had but a short time since been the property of the people. There was danger that the many still to pour into the West would by necessity become the servitors of a fortunate and early few. On this discovery our indifference at once took flight. And so out of the abuse of the nation's generosity there came a reaction against a policy that was so liberal as to be dangerous.

The nation wanted home-makers, but found its lands drifting into the hands of corporations which were withdrawing them from the market, awaiting a time when lands would be more scarce; it gave opportunity for many competing coal operators and iron manufacturers, but found the sources of raw material centering into a few large holdings; it wished its lands to be cleared of forests to make way for farms, but it found hundreds of consecutive miles reserved from use by the fiat of those who appreciated their worth, and many more miles of watershed despoiled of its needed covering in places where homes were not possible.

A REACTION WAS INEVITABLE

A reaction was inevitable. If lands were to be withdrawn from public service, why might not the government do the withdrawing itself? The old philosophy that "land is land" was evidently unfitted to a country where land is sometimes timber and sometimes coal; indeed, where land may mean water—water for tens of thousands of needy neighboring acres; for the lands of the West differ as men do, in character and condition and degree of usefulness. We had not recognized this fact when we said "land is land." Lands fitted for dry farming and lands that must forever lie unused without irrigation; lands that are worthless save for their timber; lands that are rich in grasses and lands that are poor in grasses; lands underlain with the non-precious minerals essential to industry or agriculture; lands that are invaluable for reservoir or dam sites—these varieties may be multiplied, and each new variety emphasizes the fact that each kind of land has its own future and affords its own opportunity for contributing to the nation's wealth.

So there has slowly evolved in the public mind the conception of a new policy—that land should be used for that purpose to which it is best fitted, and it should be disposed of by the government with respect to that use. To this policy I believe the West is now reconciled. The West no longer urges a return to the hazards of the "land is land" policy, *but it does ask action.* It is reconciled to the government making all proper safeguards against monopoly and against the subversion of the spirit of all our land laws, which is in essence that all suitable lands shall go into homes, and all other lands shall be developed for that purpose which shall make them of greatest service; but it asks that the machinery be promptly established in the law by which the lands may be used; and this demand is reasonable.

ALASKA HAS ENORMOUS UNDEVELOPED RESOURCES

The largest body of unused and neglected land in the United States is Alaska. It is now nearly half a century since we purchased this territory, and it contains today less than 40,000 white inhabitants, less than 1,000 for each year it has been in our possession. The purchase was made as a means of protection against the possible aggression of a foreign nation and without the hope that it would be even self-supporting. In the intervening 46 years we have given it little more than the most casual concern; yet its mines, fisheries, and furs alone have added to our wealth the grand sum of $500,000,000.

For almost a generation it was the rich harvest field of a single company. Individual fortunes have been made in that country larger than the price paid to

Russia for the whole territory. How rich its waters are we know, because they have been proved; but how rich its lands are in gold and copper, coal and oil, iron and zinc, no one knows. The prospector has gone far enough, however, to tell us that no other section of our land today makes so rich a mineral promise.

And in agriculture the government itself has demonstrated that it will produce in abundance all that can be raised in the Scandinavian countries, the hardy cereals and vegetables, the meats and the berries off which nine million people live in Norway, Sweden, and Finland. It has been estimated that there are 50 million acres of this land that will make homes for a people as sturdy as those of New England. Whether this is so or not, it would appear that Alaska can be made self-sustaining agriculturally.

This vast and unsurpassed asset lies almost undeveloped. A territory one-fifth the size of the United States contains less than a thousand miles of anything that can be called a wagon road. It has a few inconsiderable stretches of railroad which terminate, with one exception, either in the wilderness or at a private industry. Only the richest of its mines can be worked, and one of its resources of greatest immediate value to the people, its coal lands, lies unworked.

The one constructive thing done by this government on behalf of Alaska in nearly half a century was the importation of reindeer for the benefit of the Eskimo on the border of the Arctic Ocean. For the white man we have done nothing—so little, in fact, that to mention what we have done is matter for chagrin and humiliation. I have thought that perhaps the scandals that have developed in Alaska have been in some part the result of a feeling that it was a No Man's Land, where the primal instincts and powers were the only law.

SOUTHEASTERN ALASKA HAS A MORE EQUABLE CLIMATE THAN WASHINGTON, D. C.

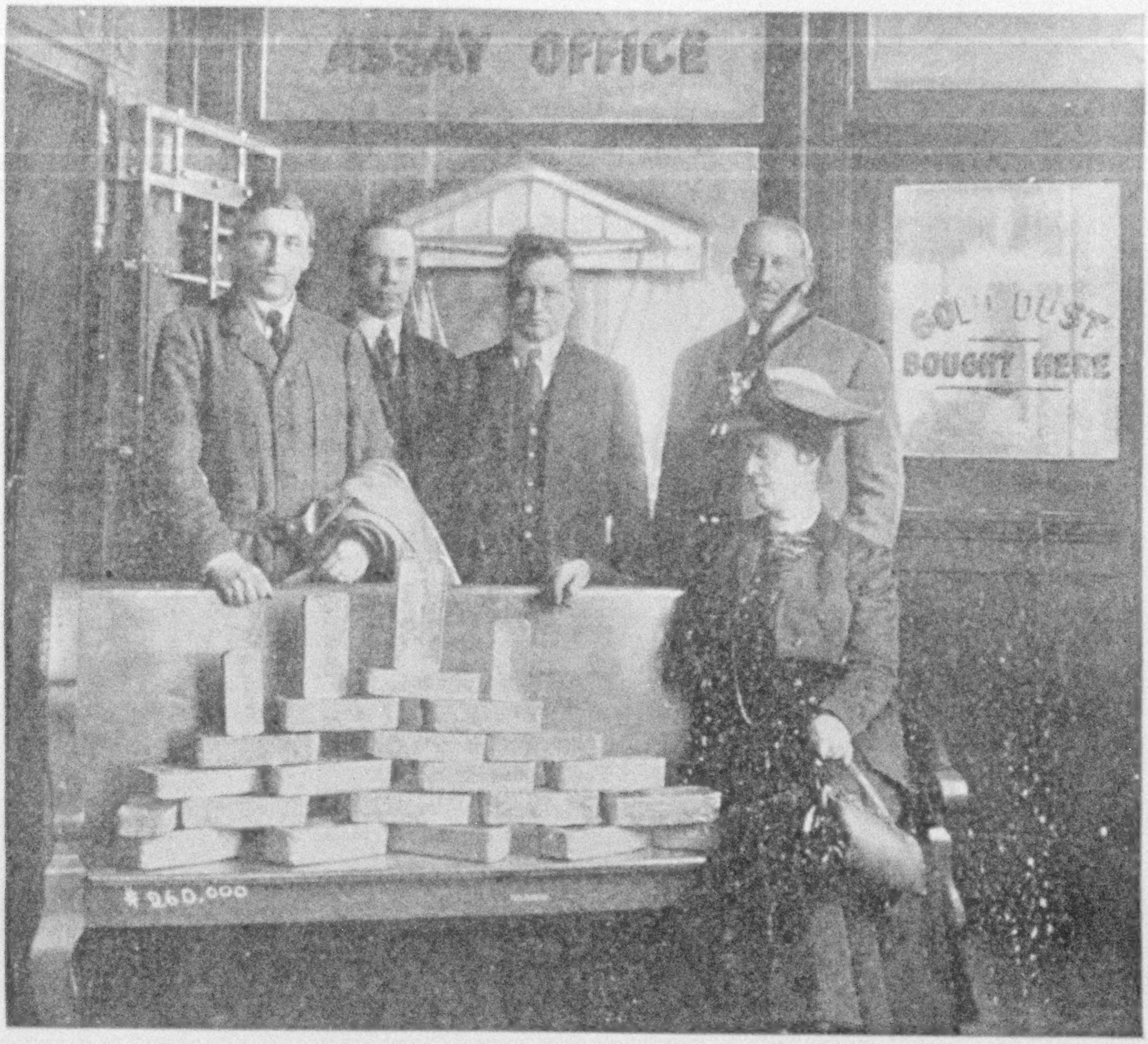
This unfortunate condition cannot be explained on the ground of the inhospitality of the Alaskan climate. A careful study of isothermal lines shows that some of southeastern Alaska has a climate more temperate and more equable than that of Washington, D. C., while much of the greater portion to the north has a kindlier climate than Stockholm or St. Petersburg. Moreover, our people are not stayed in their quest for homes or wealth by the rigors of a long winter. The spirit and purpose which brought them from Europe to Virginia and to Massachusetts take them today to Montana and Saskatchewan. The United States lately opened to entry a tract of land in Montana for which there were 46,000 applicants for registration, and only 7,000 of these could be given an opportunity to homestead. There is more railroad building 500 miles north of the Canadian border than there is for the same distance south of it.

Why has not this land been developed? The frank answer is that we did not realize until within a few years that it was worth developing. As soon as we discovered its value as a national asset we became alarmed and drew back, affrighted at the thought that we might lose it, or at least that it would become the property of those who would exploit it without respect to the public interest. Since then we have been waiting to make up our minds as to what wisely could be done. We have hesitated and halted out of the very keenness of our appreciation of what Alaska might become.

It has rather been in compliment to Alaska than in derogation of her value that we have done so little for her in late years. It was a new land, to be opened under new conditions. The mistakes made there and here we did not wish to repeat. But now, after a long pause, it would seem to be the sense of the people that we shall proceed at once and in a large way to deal with the problem of Alaskan development.

PROPOSED ADMINISTRATIVE BOARD

We have withdrawn Alaska from the too aggressive and self-serving exploiter. What have we to substitute as a safer servant of public interest? To this question I have given much thought, and my conclusion is that if we are to bring Alaska into the early and full realization



A PILE OF GOLD IN THE ASSAY OFFICE AT NOME, ALASKA

"Individual fortunes have been made in that country larger than the price paid to Russia for the whole territory" (see text, page 185)

of her possibilities we must create a new piece of governmental machinery for the purpose. We should undertake the work in the spirit and after the method of a great corporation wishing to develop a large territory.

In my judgment, the way to deal with the problem of Alaskan resources is to establish a board of directors to have this work in charge. Into the hands of this board or commission I would give all the national assets in that territory, to be used primarily for her improvement—her lands, fisheries, Indians, Eskimos, seals, forests, mines, waterways, railroads—all that the nation owns, cares for, controls, or regulates. Congress should determine in broad outline the policies which this board in a liberal discretion should elaborate and administer, much as is done as to the Philippines. This board would, of course, have nothing whatsoever to do with the internal affairs of the organized Territory of Alaska, for it would exercise no powers save such as Congress granted over the property of the United States in Alaska.

THE BLACK BEAR IS CARED FOR BY ONE DEPARTMENT AND THE BROWN BEAR BY ANOTHER

There are several reasons which appeal to me as supporting this suggestion:

1. Such a board could advise Congress as to what should be done, without prejudice, out of a deep national interest and with first-hand knowledge of conditions.

2. Such a board would coördinate the present enterprises of the government in Alaska. As it is now, the control of lands is in one department, of forests in another, of roads in another, of fisheries

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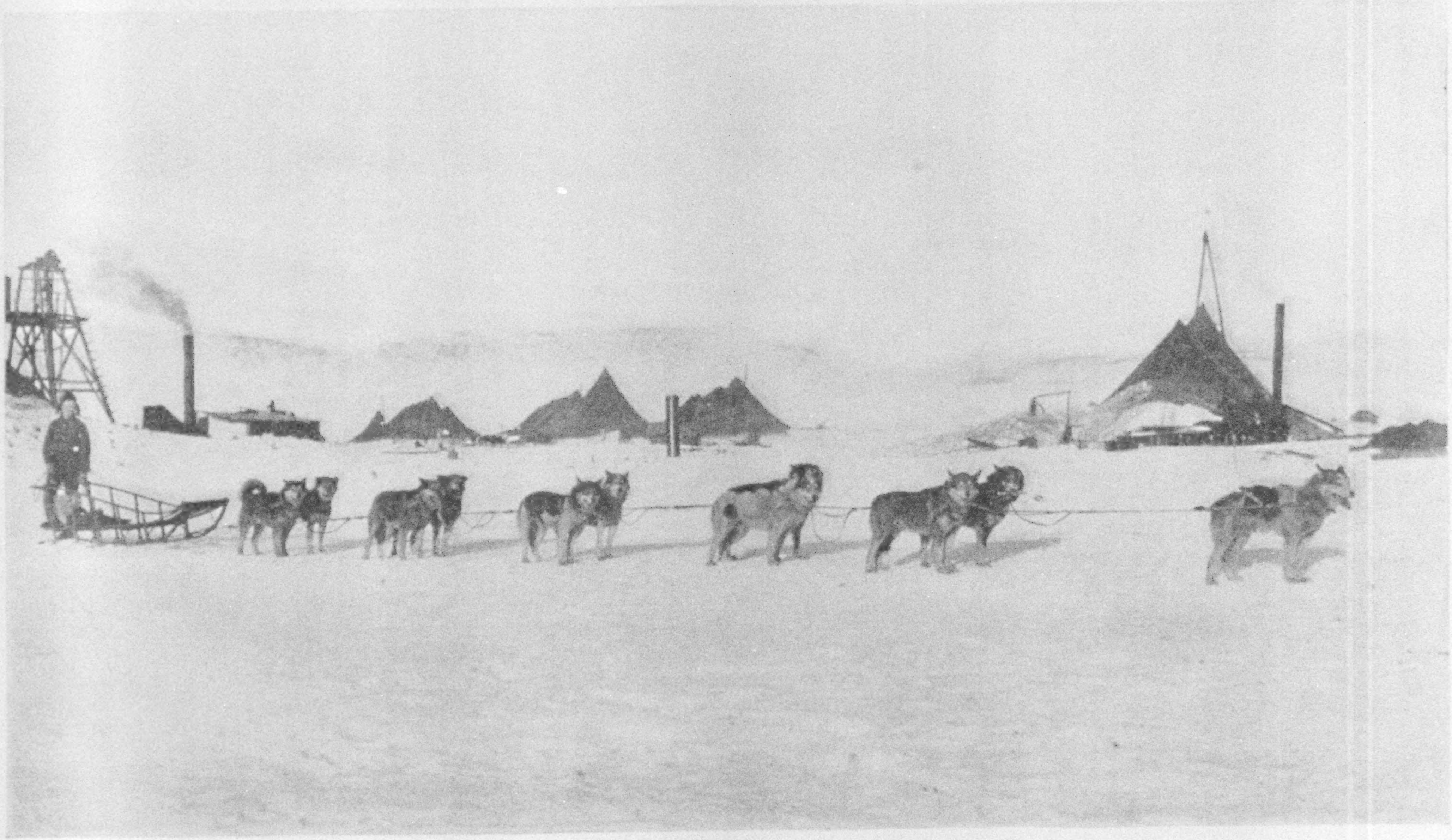

A WINTER SCENE AT NOME, SHOWING GREAT PILES OF GRAVEL WHICH ARE HEAPED UP DURING THE WINTER BY THE MINERS

During the summer, or rather as soon as water can be used without any danger of its freezing, these great piles of gravel are carefully washed by the miners and the gold extracted (see picture on page 189)

GETTING THE GOLD OUT OF THE GRAVEL IN SUMMER: NOME

in a fourth, of railroads in still another. The care of black bear is in one department and brown bear in another.

3. There can be no satisfactory administration of land laws nor any other laws at a distance of 5,000 miles from the point of action. Much less is this possible where the two sections of the country are separated by an ocean, and the land calling for attention is closed to the world one-half of the year. The eye that sees the need should be near the voice that gives the order.

4. Alaska's opening and improvement should be treated as one problem. Each step in such an administration should be part of a plan, not an isolated act. We should have a unified and consecutive program, based on immediate knowledge governing this work. Each line of activity within the Territory should be correlated with all other activities. The opening of lands and the building of railroads or wagon roads, for instance, should be part of one scheme.

5. Alaska should be developed so far as possible out of her own revenues and resources. She should have a Federal budget of her own. Her revenues and expenditures should be presented to Congress on a single sheet. The funds raised from her lands and fisheries, her furs, her forests, and her mines should be used for the construction of her roads, railroads, telegraph and telephone lines, or for any other purpose which would make her resources more quickly available to the world.

ALASKA IS ALREADY SELF-SUPPORTING

I believe it could be shown that Alaska is self-supporting today, or, what is more to the point, that by proper taxes and charges imposed upon those who are deriving large return from their enterprise in the Territory, such revenue could be derived as would support a large policy of expansion and improvement. In short, I would construct the administrative machinery that would most surely lead to a prompt and continuous development of Alaska as a part of the United States

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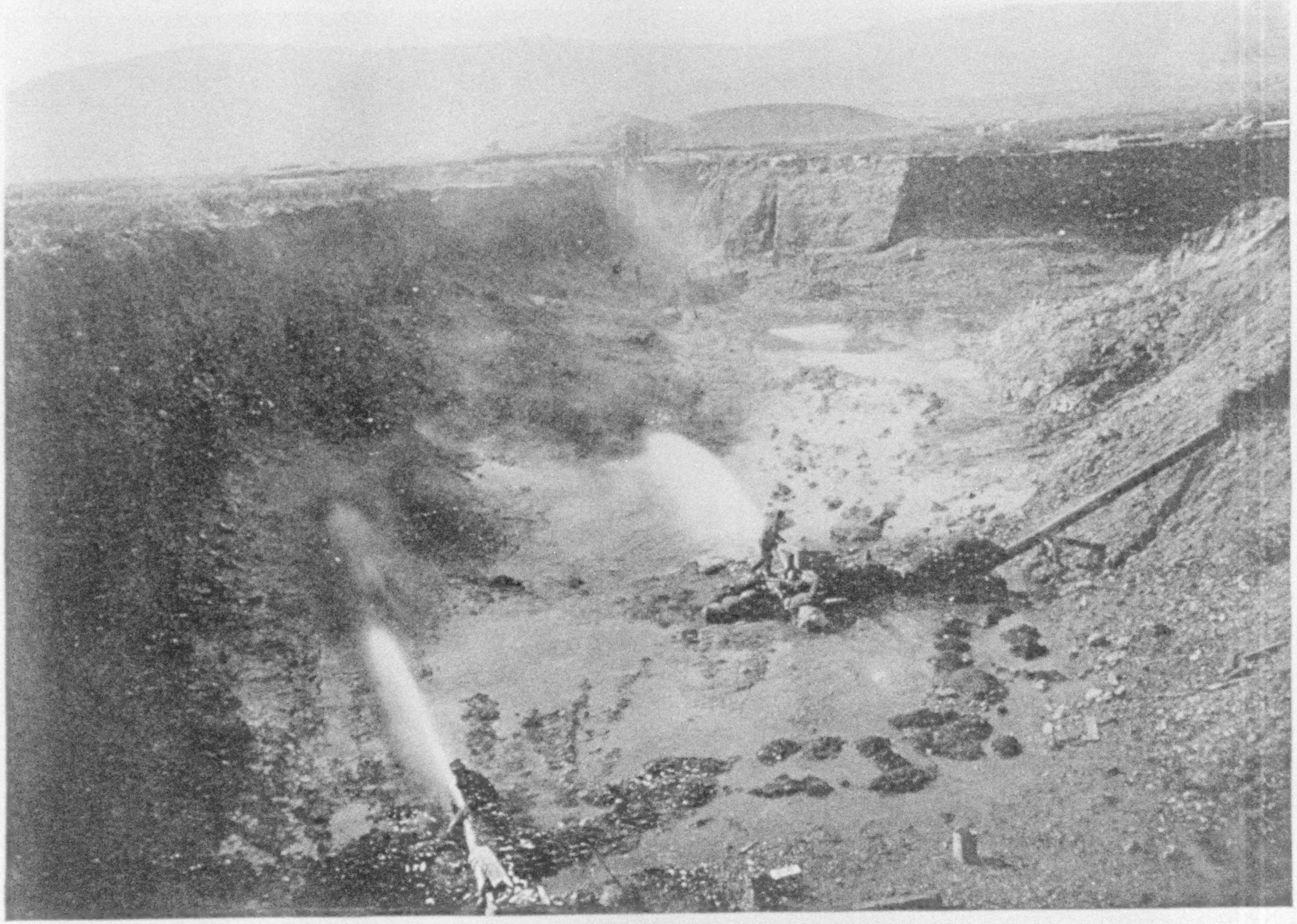


HYDRAULIC MINING IN GLACIER CREEK, NOME

The gold placer fields of interior and northwestern Alaska no longer give employment to as many men as in former years, because of the adoption of new methods of mining. The gold output is still large, the amount produced in 1912 being valued at more than $17,000,000 upon a plane commensurate with her possibilities industrially, agriculturally, and socially.

The members of such a board appointed by the President would be selected presumably with reference to their fitness for the work to be done. Each one could be made the administrative and residentiary head of a department or division, so that there might be a commissioner of the Alaskan land office, another commissioner of highways, another, perhaps, commissioner of Indian affairs and fisheries, and so on. All would sit together, as in the commission form of municipal government, and would work for a common end, the upbuilding of Alaska as an integral and contributing part of the Union.

I apprehend the fear that with such a commission there would be danger of corruption or indifference creeping into its work. This, however, is incident to the bestowal of all authority. The commission would not go unchecked, of course, for it must report to the head of some department at Washington, and through that head to Congress, and would be always subject to investigation. Moreover, no method has yet been invented by which dishonesty or poor judgment can be guarded against in public or in private life. In the end the character and wisdom of the men appointed is the only insurance that can be given against conduct that is foolish or worse.

Alaska should not, in my judgment, be regarded as a mere storehouse of resources upon which the people of the States may draw. She has the potentialities of a State. And whatever policy may be adopted should look toward an Alaska of homes, of industries, and of an extended commerce.

WHAT SHOULD BE DONE AT ONCE

Strongly as I would urge this method of management—for it offers a rare opportunity to exhibit the efficiency of a republic—I would not have Alaska wait for needed legislation until the merits of such a plan could be passed upon by Congress. Those things which appeal to me as of immediate necessity upon which independent action may be taken are (1) the construction of railroads in the Territory and (2) the opening of her coal lands.

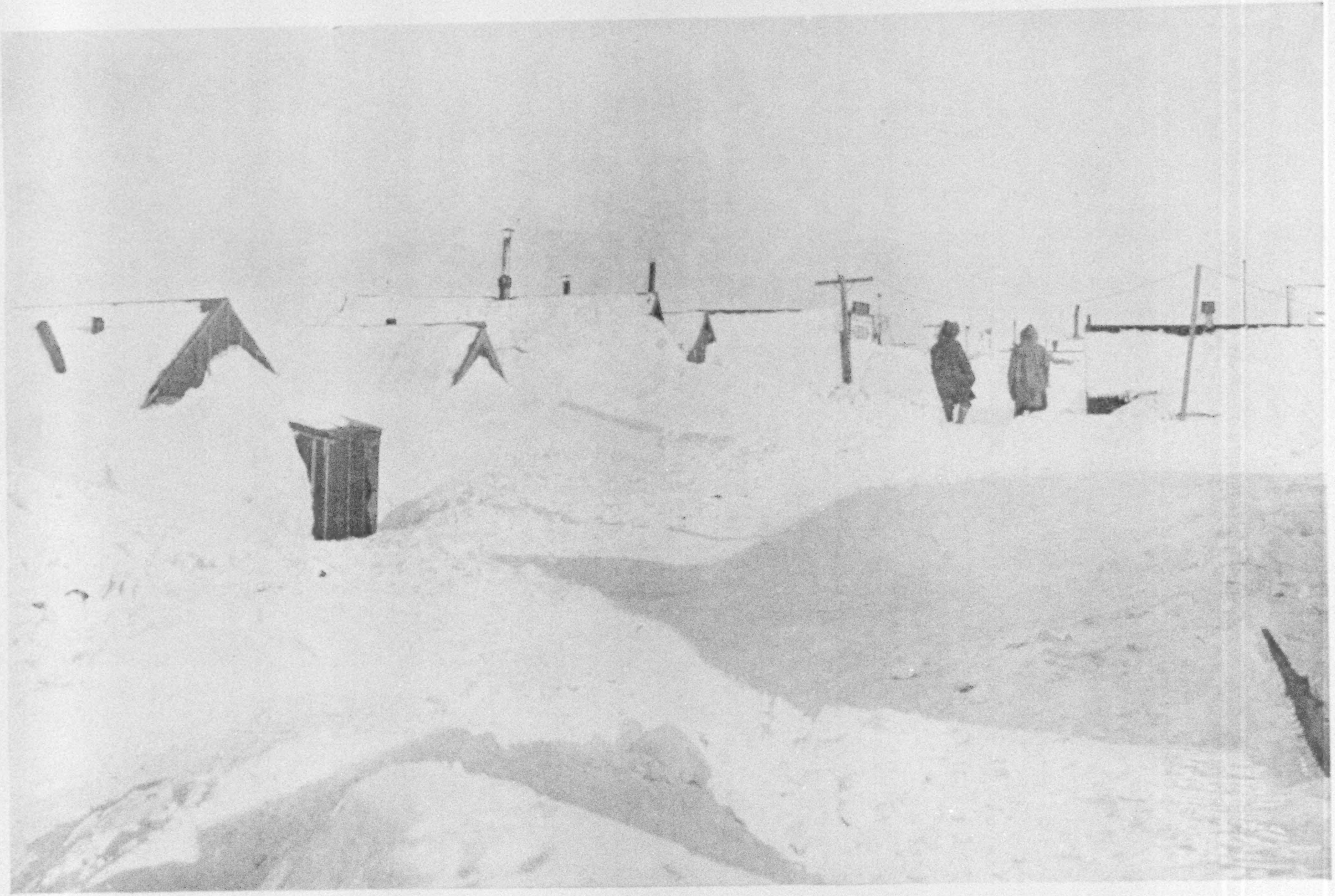
I have already expressed to Congress my belief that it was wise for the government itself to undertake the construction and operation of a system of trunk-line railroads in Alaska. And I am led to this view irrespective of the possibility of private enterprise undertaking such work, although my belief is that no railroads would be privately constructed in Alaska for many years to come excepting as adjuncts to some private enterprise. Be that as it may, it would seem wise for the government to undertake this task upon grounds of state.

The rates and the service of such railroads should be fixed with reference to Alaskan development—not with regard to immediate returns. The charges fixed should be lower for years to come than would justify private investment.

I would build and operate these highways in the same spirit that the counties or the States build wagon roads—not for revenue, but for the general good. After all, a railroad is little more than an operated wagon road. In many countries they still call railroad cars "wagons." Our laws as to railroads are evolved from our old laws as to carriage by wagon. Our courts speak of railroads as property charged with a public interest and so justify the regulation of their rates. But no court would justify the imposition of rates made for the purpose for which Alaskan rates should be made—the creation of a Commonwealth. If this is our task, it should be done whole-heartedly and with a consciousness that the dollar spent today on an Alaskan railroad will yield no more immediate return on the investment than the dollar spent on the Panama Canal.

WHY THE GOVERNMENT SHOULD BUILD THE ALASKAN RAILROADS

These, then, are the persuading reasons for the belief that the government should undertake to drive from the coast inland one or more lines of railroad: (1) The government already regards it as its duty to build wagon roads. Such roads when well built are almost as costly as



GOLD AVENUE AT NOME IN WINTER

the construction of a railroad, which is the essential modern means of transportation. (2) There can be no assurance that without surrendering our resources in Alaska private railroads will be built. (3) The opening of this new country demands that the highways of travel and commerce should be made wholly subservient not to private interest, but to the upbuilding of this territory, that they may be the real servants of the national purpose.

If it is thought wise to recoup the government for its original outlay, it can be done, at least in part, by following a plan not unknown to our people—by giving a land subsidy to the owners of the road. Retain in the government one-half of the land on each side of the railroad until it has appreciated in value by the growth of the lands given to the public. Thus the government would subsidize itself and reap some of the benefits accruing to its land from the construction of the road. Judging by the increase in land values in the newly opened sections of Canada, who could say but that long before the bonds were due the government would thus have an asset sufficient to meet the original debt?

There seems to me no necessity for barring the way to minor privately owned roads because of the presence of longer systems of publicly owned roads. The two exist together in other countries. I would not even apply the principle of the commodities clause of the act to regulate commerce to such roads. They should be built, however, under governmental supervision, capitalized and operated under the strictest regulation, and be at any time subject to purchase by the government at their cost, minus depreciation.

THE VALUE OF ALASKAN COAL

It is not necessary to set forth here the extent or character of the coal fields of Alaska. Neither could I add to your knowledge or that of Congress as to the need for this coal both by the navy and by the industries and the people of the Pacific coast generally. There are almost unlimited quantities of a high grade of lignite in the interior which may not stand extended storage or transportation. This could be converted into electricity at the mouth of the mines and widely distributed for lighting, heat, and power. Toward the southern coast of the peninsula there are two well-known fields of a high-grade bituminous coal and some anthracite. These are the fields which have given rise to the troubles with which all are familiar.

These coal fields should be opened not to speculators, but to operators. Those should have these lands who will use them. None should be opened as a basis for a gamble in future values. If these premises express a sound public policy, there appears to me but one conclusion that can be reached as to the manner in which they may safely be turned over to the public—under a leasing and royalty system similar to that under which the State of Minnesota leases its ore lands and the States of Montana and Colorado their coal lands.

The tracts opened should be disposed of to those who within a certain time would develop mines and make their product commercially available. This means that where a railroad is necessary to the operation of a mine the applicant should take a lease so conditioned for a limited period. Sufficient land should be leased as a body to justify long-continued and economical operation. As the average of all operations in the United States is 2,600 acres, including many small holdings, this might be taken as a maximum unit.

There has been much dispute between those who favor making a lease for an indeterminate period, dependent alone upon continued operation, and those who believe it wisest to fix a term for the lease, 20, 30, or more years. This dispute seems to me of much more academic than practical interest. There should be no disposition to change the lessee. If a fixed term of lease is decided upon, the original lease should have an assured preferential right to a renewal until the mine is worked out. So that in the end the fixed term is a reservation of the right on the part of the government to make new terms at the end of a number of years, a reservation which could be fixed in an indeterminate lease.

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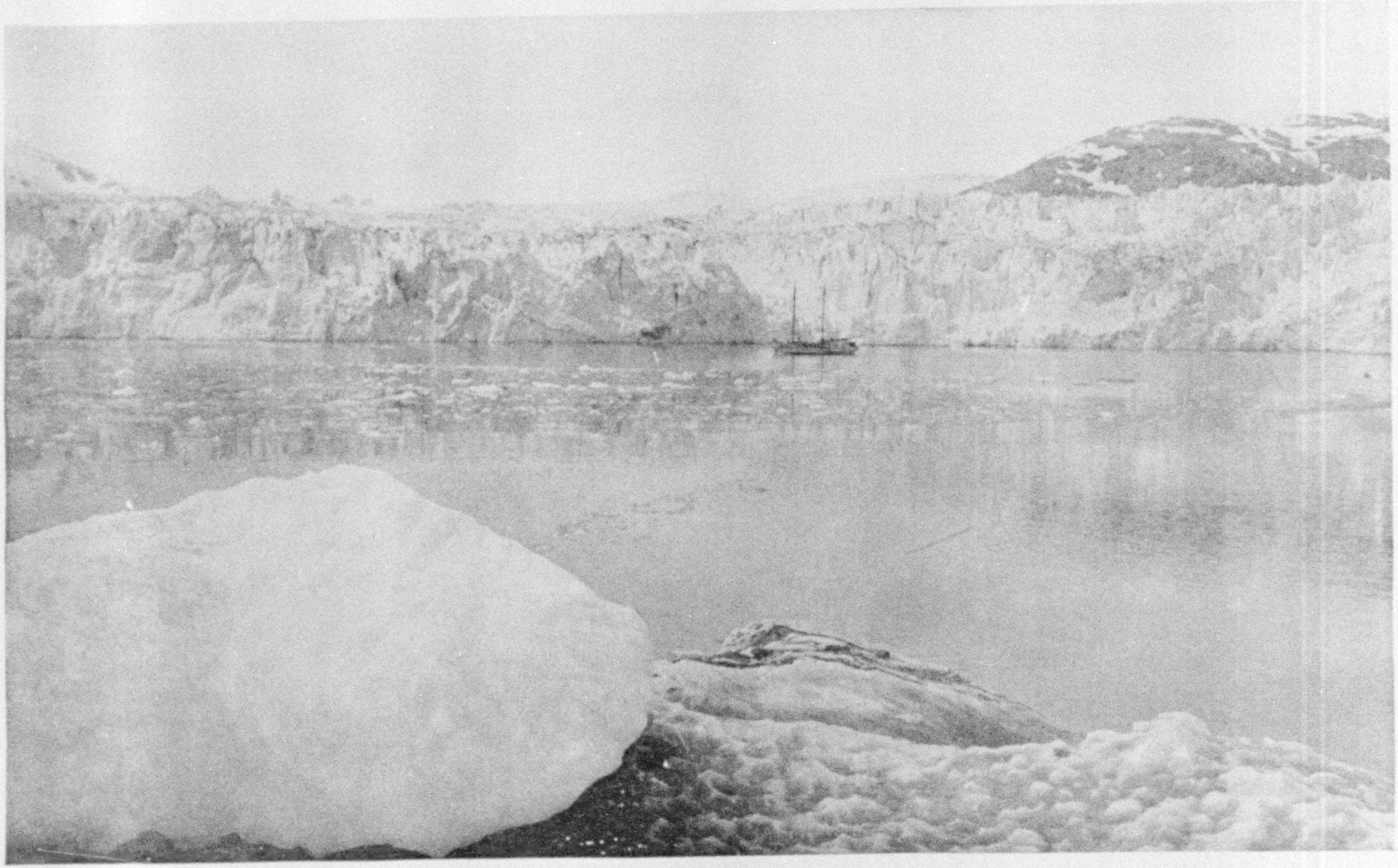

Photo from F. E. Kleinschmidt

THE MUIR GLACIER: ALASKA

This glacier, one of the largest in the world, has a frontage of seven miles along the sea. During the summer it affords a wonderful spectacle to tourists, for great masses of ice, often larger than an average house, break off and plunge into the water

SOME COAL LANDS SHOULD BE HELD FOR THE NAVY

A fixed minimum annual royalty would conduce to operation and prevent the holding of lands out of use. These are matters, however, of regulation upon which much thought should be expended, and the experience of other lands will be found helpful. If the principle of the homestead law is adopted, and one lease only permitted to any one person or group of persons, and all leases made non-transferable, excepting with the consent of a designated authority, it would seem that monopoly could be prevented. I would, however, add one other precaution—that in each field a large body of the coal land be reserved, so that the public and the navy might be rendered independent of private supplies if that should become necessary.

The attraction of a leasing system is that it enables an operator to put all of his capital into the promotion of his enterprise, no investment being needed for the purchase of the land. This makes it possible for the man of comparatively small means to become a coal mine operator. The lessee is pleased to pay the government a royalty in lieu of tying up a large amount of capital in the land itself.

There is this further consideration, which those interested in Alaska's future might well consider. The royalties arising from these mines (as well as from oil) would for a long time be a source of revenue to the government. To stimulate the opening of mines, all royalty might well be waived for a brief period; later, however, these royalties would be a not inconsiderable addition to the resources available for Alaskan development, for I would think it the wisest policy to give to this new land the full return from her properties to be used in her improvement, at least for many years.

WESTERN COAL

There are many isolated places in Alaska where small mines may be opened to supply a local and small need. A license to mine a small acreage without any charge whatever on the part of the government would meet this need.

It might be well at this point to consider the coal land situation in the Western States. For the policy I have suggested as advisable to apply in Alaska I think the sensible policy to adopt throughout the rest of the country. We have tried two experiments in the United States as to coal lands. We allowed our coal lands to slip from us under the old land-is-land policy until we came into the presence of a coal monopoly or a series of such monopolies in various parts of the country. If this is questioned we may at least say, with exactness, that we realized that we had been putting priceless assets into the hands of a comparatively few far-sighted men for an inconsiderable consideration.

Then we tried the other plan of appraising such properties on a scientific estimate of contents upon which the land is sold. This is the present plan, and it is really nothing more than a demand for a full but discounted royalty in advance. It has against it, in my opinion, at least two objections. Our coal land is not being used under this plan save under exceptional conditions of local and immediate demand, and the purchaser, when there is one, is speculating on the best guess that an honest geologist can make as to the amount of coal in the ground.*

It is certainly not for the public interest that our coal deposits shall be opened rapidly and ruthlessly. We may reforest lands that have been devastated, or feed again into fruitfulness a soil that is starved, but we cannot replace the car-

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*The outstanding withdrawals of public lands valuable for mineral fuels and fertilizers or in connection with the water resources of the public domain now aggregate 66 million acres. The coal-land withdrawals awaiting classification constitute the larger part of this acreage, being 56,316,410 acres on December 4, 1913, not including the blanket withdrawal of coal lands in Alaska. It is noteworthy that a larger area than this has been restored within the past five years, and nearly 20 million acres have been classified as coal lands and are open to entry at appraised prices. The lands classified and restored by executive order to appropriate entry since March 4 last total 10 million acres, every restoration being based upon careful consideration within the Department of the Interior. About 400,000 acres of mineral lands in the same nine months have been withdrawn.

Photo by W. T. Lopp

TRAVELING WITH REINDEER IN ALASKA

"The one constructive thing done by this government on behalf of Alaska in nearly half a century was the importation of reindeer for the benefit of the Eskimo on the border of the Arctic Ocean. For the white man we have done nothing; so little, in fact, that to mention what we have done is matter for chagrin and humiliation" (see text, page 186).

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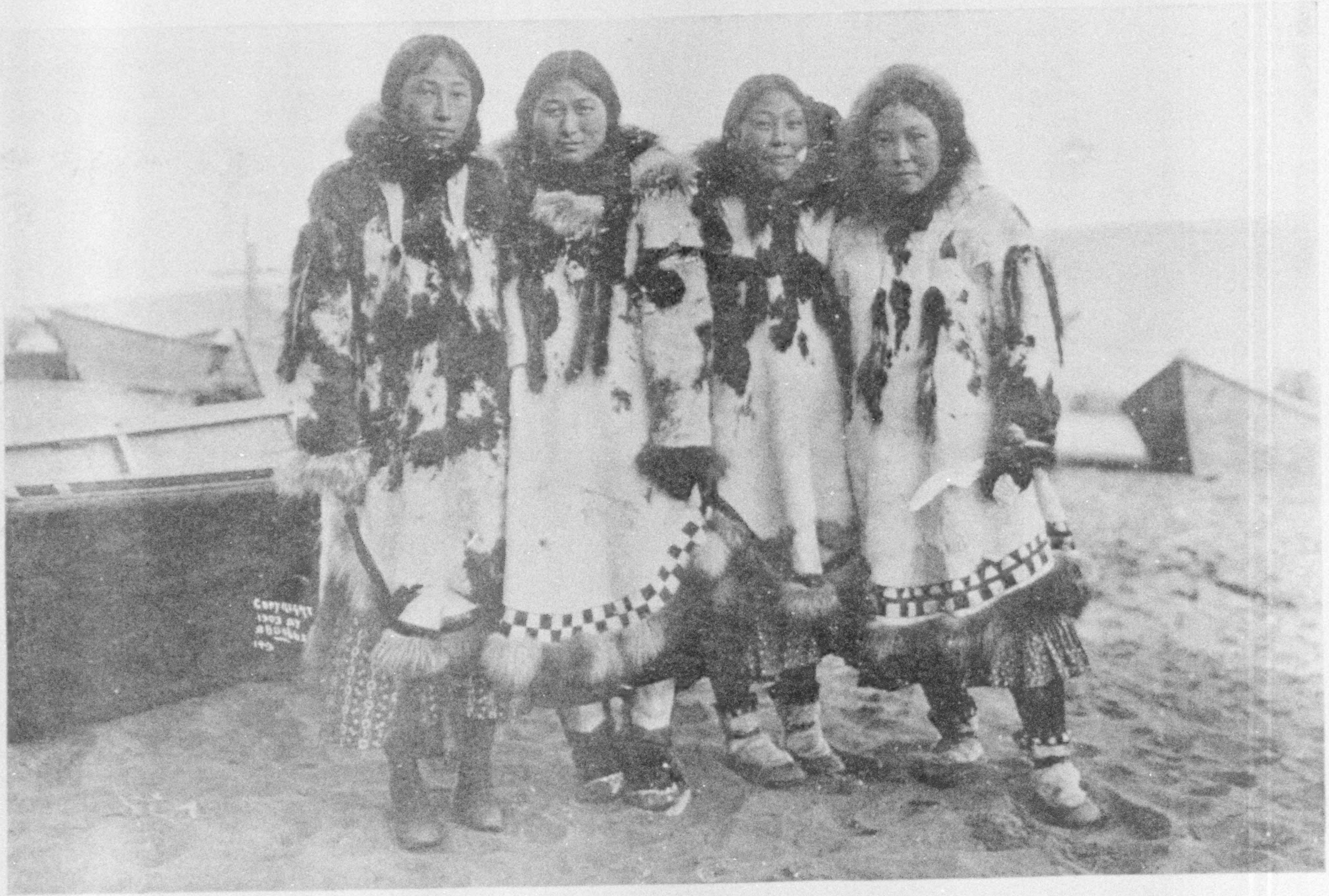
Photo by W. T. Lopp

HERD OF REINDEER ON A HILLSIDE IN ALASKA

In 1891 Dr. Sheldon Jackson brought 16 reindeer across the Bering Strait into Alaska; today that herd, with a few importations since, has increased to nearly 40,000, of which some 62 per cent are owned by the natives. From their herds of reindeer the natives enjoyed last year an income of $44,885.



FOUR ESKIMO GIRLS NEAR CAPE NOME, ALASKA

The dress of the Eskimo consists entirely of skins of seal, reindeer, bear, and fox, the first two being the most common. The dress of the women differs but little from that of the men—a suit with a long jacket and trousers tucked into seal-skin boots. The jacket, which has a hood to cover the head, is often embroidered with strips of dyed leather and is skillfully made. In winter two suits are worn, one with the fur inside, the other with it outside.

bon deposits underground, once they are removed. I cannot, however, feel that we should sacrifice any present need for fuel or willingly surrender ourselves to a demand for exorbitant prices because of a fear that some day the coal supply may be exhausted (see page 205).

Already there has been developed a substitute for coal in the flowing stream. The turbine converts melted snow into heat and light, which can be distributed over a constantly widening area. I think we have now arrived at that point in scientific achievement which justifies the belief that the wheels of industry will not cease, nor our houses go unlighted or unheated, so long as dams may be built upon our streams. Water will be—indeed already is—the greatest conservator of coal.

We must seek to make use of our coal, the fullest use that society requires. This principle seems a truism. But here lies the difficulty. We wish cheap coal and at the same time a minimum of waste. We wish society to take the lion's share of the profit and yield no more to the operator than will make his work sufficiently attractive to keep him at it. In short, we desire competition without waste—a frank impossibility.

Other countries have wrestled with this problem. Some have gone into government operation. But those who are nearest to us in institutions and tendencies have found that in a new country, where there must be large development and higher rewards for enterprise, the safest practicable method is to lease the land, the government taking a modest royalty and retaining some measure of control over operation.

OUR OIL, PHOSPHATE, AND POTASH DEPOSITS SHOULD BE DEVELOPED

The United States is beginning to appreciate the extent and value of its oil deposits, and for the disposition of these lands no better plan has been suggested than one analogous to that offered as to coal lands.

I would call your attention to the absurdity of applying the placer mining law to the development of petroleum lands. This law, which was based upon the fundamentals of the miners' codes of early days, was passed without thought of the occurrence of other deposits than placer gold. However, the land department, and later Congress, applied the law to oil lands.

The placer law provides, in the main, that no location shall be made without a discovery of valuable minerals on the claim, that the boundaries of the location shall be plainly marked on the ground, that no claim for an individual shall exceed 20 acres or for an association 160 acres, that $100 worth of assessment-work must be done each year, and that upon the expenditure of $500 in labor or improvements and upon compliance with certain minor requirements the claimant is entitled to a patent to his claim.

The claimant who has gone upon lands for the purpose of making mineral location, and is engaged in work looking to the discovery of minerals, is protected against adverse agricultural claimants on the ground that the land which he occupies is not vacant and open to settlement. The extent of his protection against adverse mineral claimants is, however, a matter of serious doubt. He cannot be ousted by the forcible or fraudulent entry of another mineral claimant, but if such adverse claimant enters peaceably, openly, and in good faith, prospects the claim and first discovers minerals, thus perfecting his location, his title is superior and he dispossesses the original occupant.

On the other hand, in some of the fields large areas are held indefinitely by assessment-work which makes little pretense of exploring the claims or developing them. Useless roads which make the claims no easier of access, drilling rigs incapable of reaching the oil sands, building-stone locations where no building stone is to be found, and locations on worthless deposits of gypsum are among the subterfuges adopted to hold possession of lands prospectively valuable for oil.

Thus, where occupancy without discovery is respected, large areas are withheld from exploration and development, and where such occupancy is not respected the oil prospector must assume undue

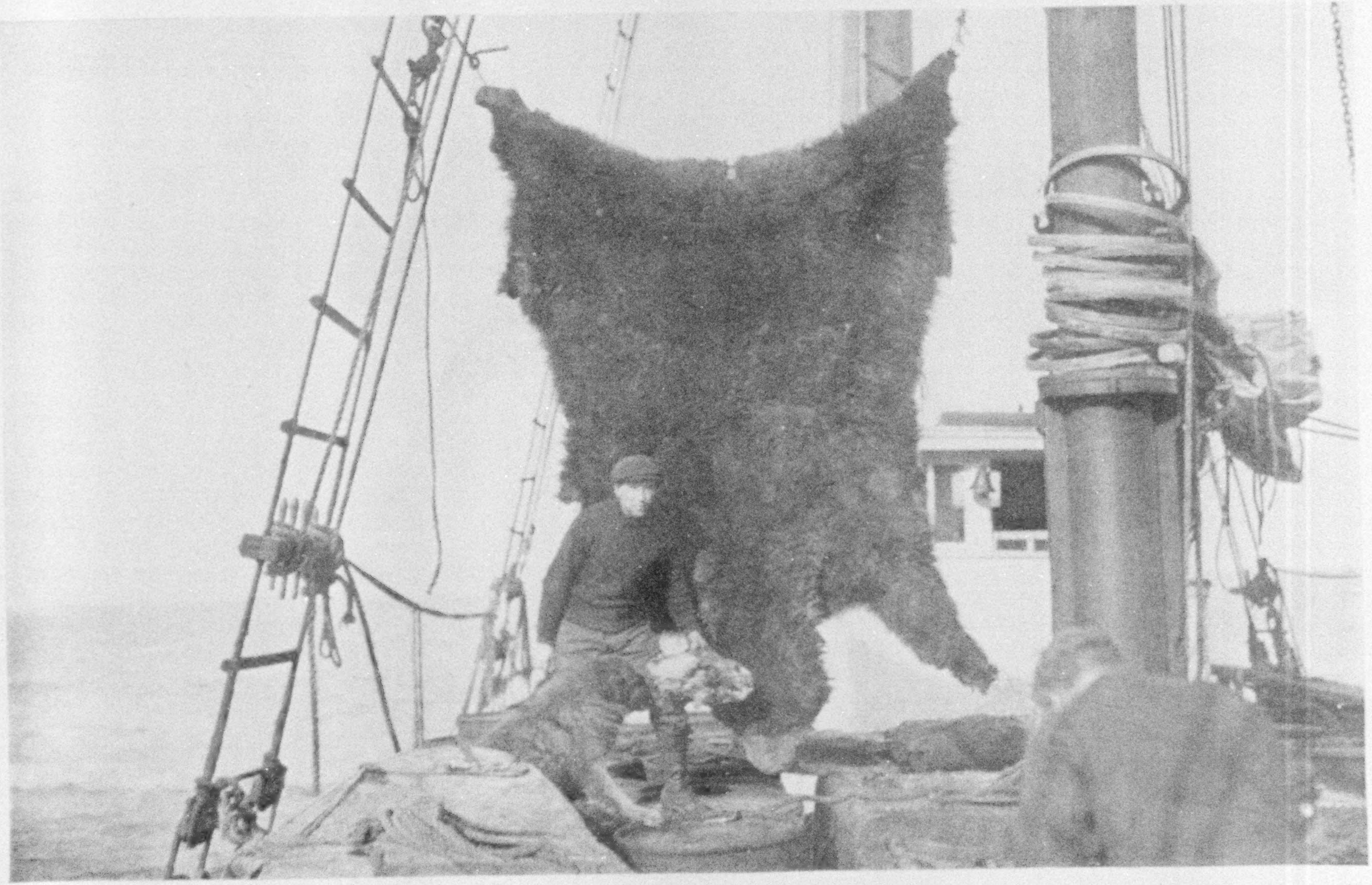


Photo from F. E. Kleinschmidt

THE SKIN OF AN ENORMOUS ALASKAN BEAR

This bear, whose skin measured 12 feet 8 inches in length, was killed near Kodiak, in Alaska, for the collection of the Carnegie Museum at Pittsburgh. The man and the large St. Bernard dog bring out the great size of the skin

XUM

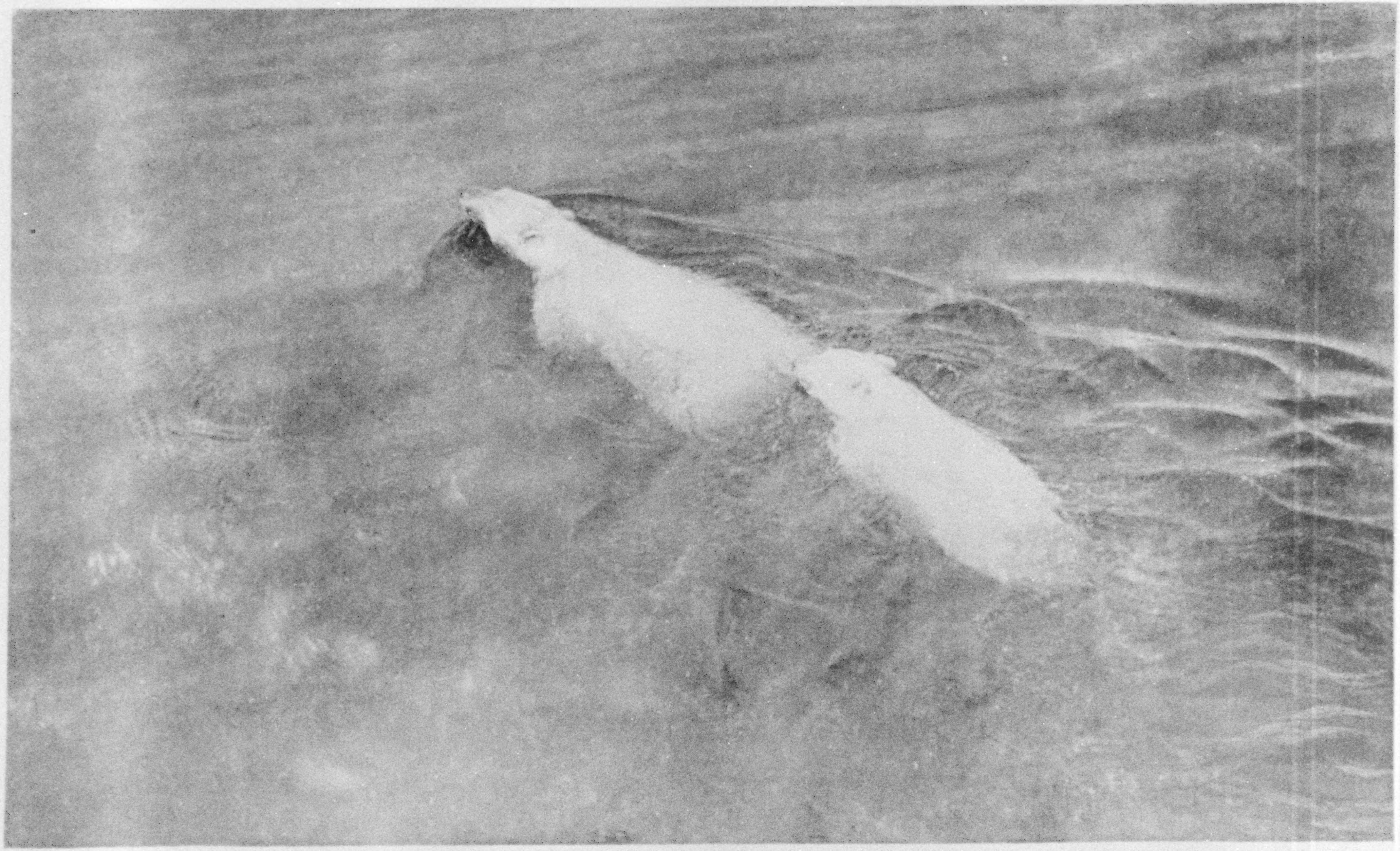


Photo from F. E. Kleinschmidt

POLAR BEAR AND CUB OUT FOR A SWIM

The cub hangs on to the mother's tail and is towed along. Sometimes the mother objects to this, and, turning round, severely cuffs the baby or takes it by the neck and puts it under water

HAULING A BOILER IN ALASKA

"A territory one-fifth the size of the United States contains less than a thousand miles of anything that can be called a wagon road. It has a few inconsiderable stretches of railroad which terminate, with one exception, either in the wilderness or at a private industry. Only the richest of its mines can be worked, and one of its resources of greatest immediate value to the people, its coal lands, lies unworked" (see text, page 186).

ALASKA BUREAU

Photo from Leonard Davis

A PAIR OF SALMON, ONE WEIGHING 65 POUNDS AND THE OTHER 82 POUNDS, CAUGHT AT KETCHIKAN: THE PORPOISE SHOWS THE COMPARATIVE SIZE OF THE SALMON

risk of the loss of his investment prior to discovery.

PRESENT MINING LAWS DO NOT SUFFICIENTLY REWARD PETROLEUM PIONEERS

An objection of equal force to the placer law as applied to petroleum arises from the fact that the mineral is fluid. It moves underground. A well on one tract is likely to draw from a neighboring tract. Thus it becomes necessary for each operator to drill wells along his boundary lines before his neighbors do so. Otherwise, they will draw off a part of his oil. He is therefore forced to drill whether it is otherwise to his advantage or not, in order to protect his oil deposits from exhaustion through adjacent wells.

We should, I believe, stimulate the search for oil and protect the prospector. The government is withholding from entry certain considerable bodies of land in the belief that they contain oil, when this has not been demonstrated. It is our practice as soon as there has been a producing well discovered, and sometimes earlier, to withdraw all lands in the neighborhood which, in the opinion of experts, are of similar geological formation. The lands on which the discovery has been made or upon which exploration has been begun may or may not be included in the withdrawal. If they are, the law offers to protect the rights so acquired.

I feel, however, that we are not sufficiently rewarding the pioneer. A plan could readily be evolved by which any one wishing to prospect for oil on the public lands could obtain a license from the government to prospect exclusively a large tract of land for a period of time—perhaps two years—and in the event that oil is found in commercial quantities the government should be paid a royalty fixed in advance.

This method is similar to that by which the Indian lands in Oklahoma have been developed and which has proved of the highest value in bringing capital into this

XUM

Photo from Leonard Davis

TURNIPS WEIGHING 12 POUNDS GROWN IN A PRIVATE GARDEN AT RAMPART, ALASKA

"And in agriculture the government itself has demonstrated that it will produce in abundance all that can be raised in the Scandinavian countries, the hardy cereals and vegetables, the meats and the berries off which nine million people live in Norway, Sweden, and Finland. It has been estimated that there are 50 million acres of this land that will make homes for a people as sturdy as those of New England. Whether this is so or not, it would appear that Alaska can be made self-sustaining agriculturally" (see text, page 185).

work and insuring large returns to the Indians. In the Oklahoma case one great corporation, however, was given so large a body of land that after the original discovery it found it profitable to farm out its rights to subsidiary companies. This might easily be prevented by regulations under which the government would reserve to itself the adjoining lands.

Indeed, I would not be adverse to granting such a license in unexplored country for, say, four sections of land, and in the event of discovery permitting patent to issue to the discoverer for a full

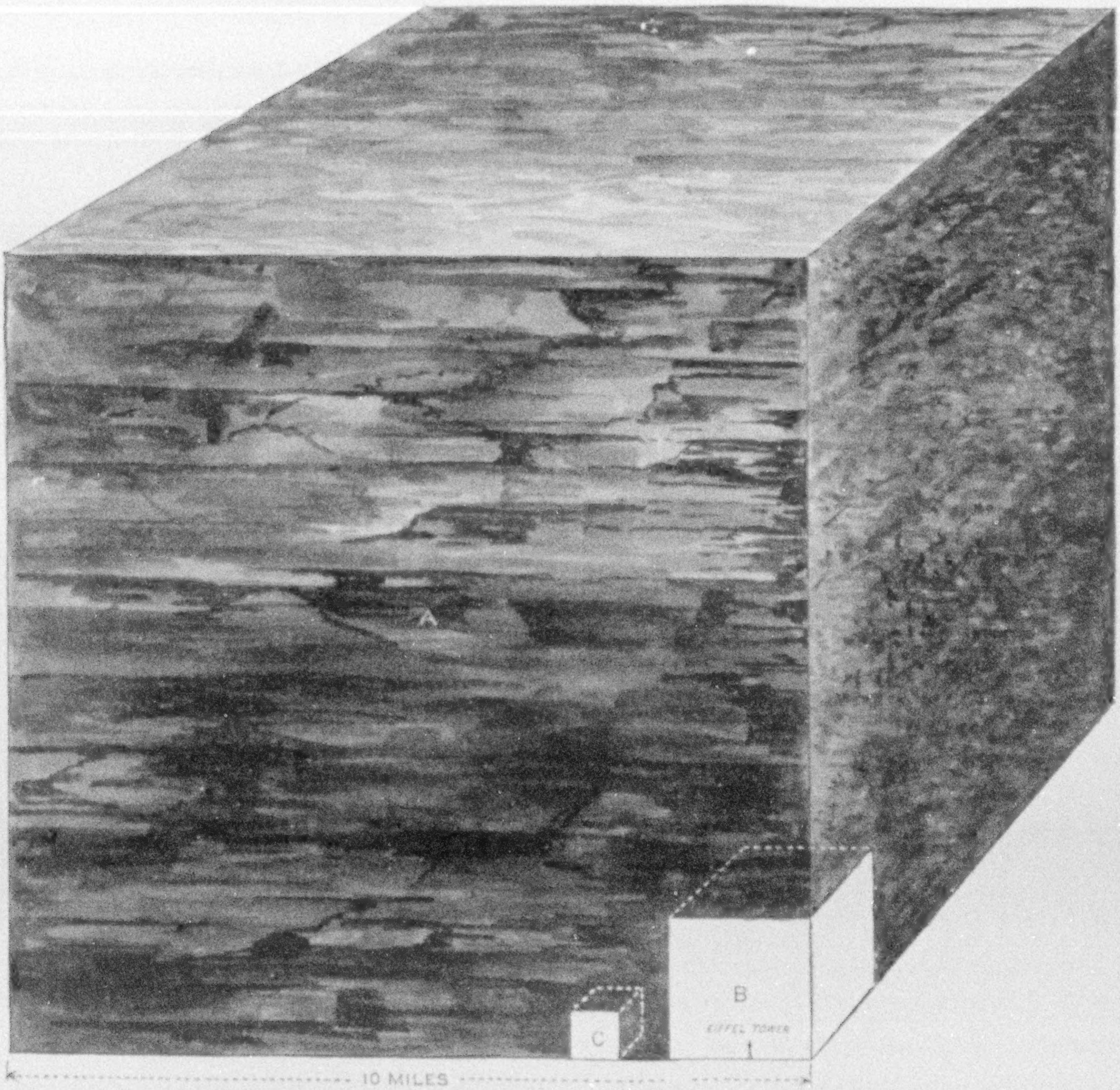


DIAGRAM ILLUSTRATING OUR COAL RESOURCES, THE AMOUNT THAT HAS BEEN USED AND THE AMOUNT STILL REMAINING UNUSED IN THE UNITED STATES

A represents the total coal supply of the United States. B represents the amount used to the end of 1912. C represents the amount consumed in a single year. This diagram was prepared by Edward W. Parker, Chief of the Division of Mineral Resources of the U. S. Geological Survey.

section, the balance of the licensed land to remain in the government to be leased in small parcels to other parties on a royalty basis under the more advantageous terms that could then be secured.

THE NEED OF OIL FOR THE NAVY

The United States will need oil for its navy as well as coal, and probably in increasing quantities as the modern oil-burning or gas-burning engines are recognized. It would be economical to substitute oil for coal for many reasons; to reduce labor cost, to avoid the building and maintenance of colliers, and the purchase and support of coaling stations.

The Diesel engine can, with the fuel carried from the home port, take one of our greatest ships around the world without dependence upon a renewed supply of fuel. England's adventure in this direction will presumably force other nations into like enterprise, and yet England has no oil fields on which to draw, while we have already the largest producing fuel-oil fields in the world, and others are appearing.

Already we know of oil in Alaska, and

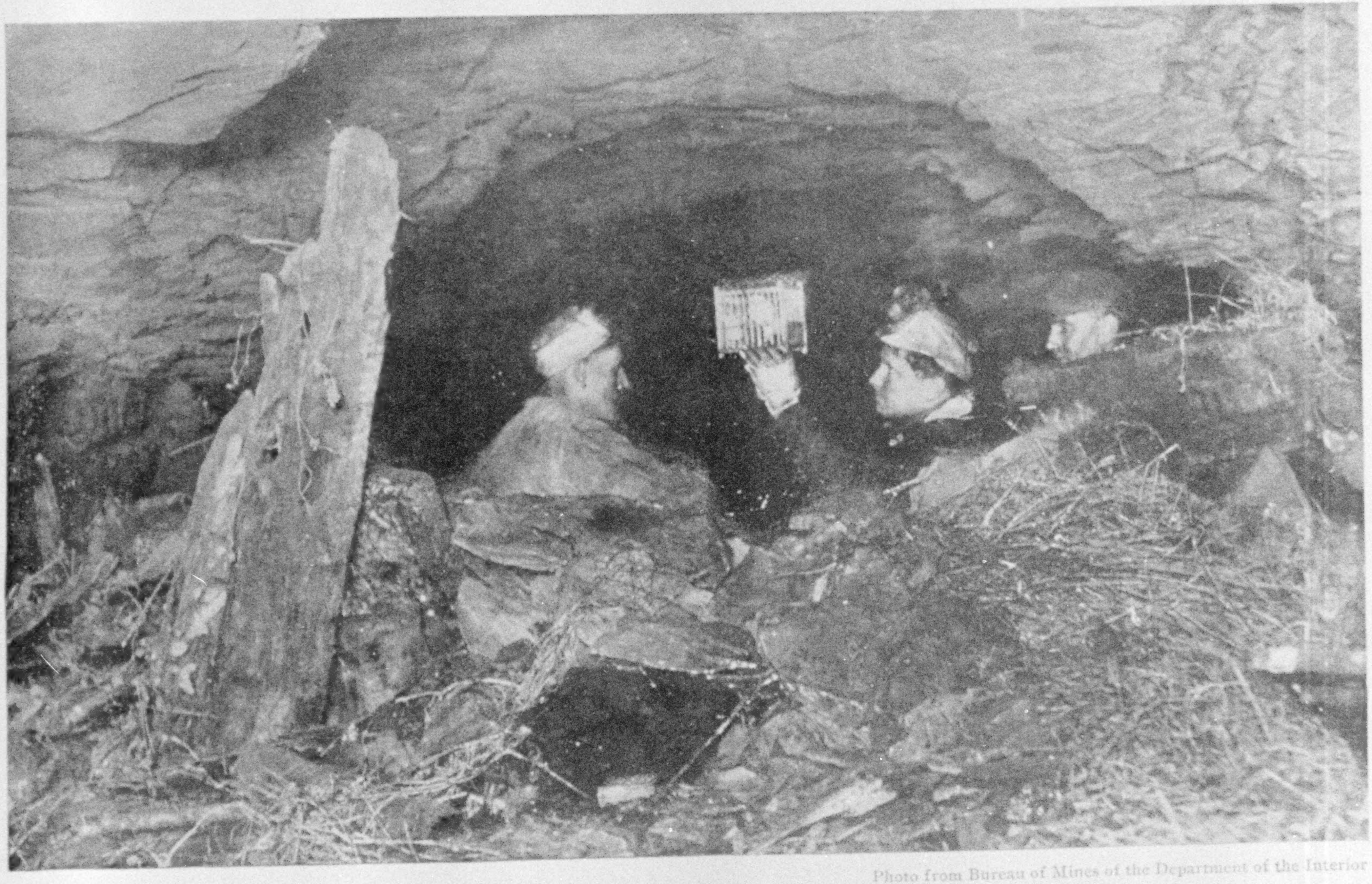


Photo from Bureau of Mines of the Department of the Interior

A CANARY USED AS A PROTECTION IN MINE RESCUE WORK

It has been found that canaries will show signs of distress at the presence of harmful gases in mines long before human beings are aware of any danger. It is now the practice to carry one of these birds with all rescue parties, as it will indicate the point beyond which it is not safe to proceed without wearing protective helmets.

within a few weeks a fine grade of oil has been found on the Quinaielt Indian Reservation in Washington. The Indian oil lands we do not own. They belong to the Indians, and their product must be sold for the Indians' profit.

The one sole reservation of oil lands for governmental use is that in California, over the withdrawal of which litigation is now pending. Under these conditions it would seem of the highest expediency that the government make such offers as will induce the proving of our lands, and of these proved lands retain sufficient to make our ships independent of the world and as fully competent as their rivals.

Some years since the Department of the Interior announced the discovery within the United States of a deposit of potash which it was hoped would render our farmers independent, for a time at least, of all other sources. This deposit still lies unused. No proper laws have been passed by which it can be put into use. A common-sense view of the matter would be to treat these lands as it has been suggested we should treat coal lands.

So, too, should our vast deposits of phosphate rock, undoubtedly the world's world's supply. We are giving a constantly increasing volume of thought to the scientific methods by which the fertility of our soils may be increased. And the time is likely to come when the deposited phosphorus in our western lands will be regarded as of almost priceless worth.

Few appreciate how very extensive these deposits are. They run for hundreds of miles through Wyoming, Utah, Montana, and Idaho, and in other States similar deposits of lesser extent are known to exist. We have millions of acres of phosphate lands which are estimated to contain several billion tons of phosphate rock; undoubtedly the world's largest known reserve. In 1910 the United States produced 52 per cent of the world's output of phosphate rock, and last year over 40 per cent of our product was exported. It would certainly be well if we could insure the preferential use of this fertilizer on American farms and export it in the form of farm products rather than as raw material.

TIMBER LANDS

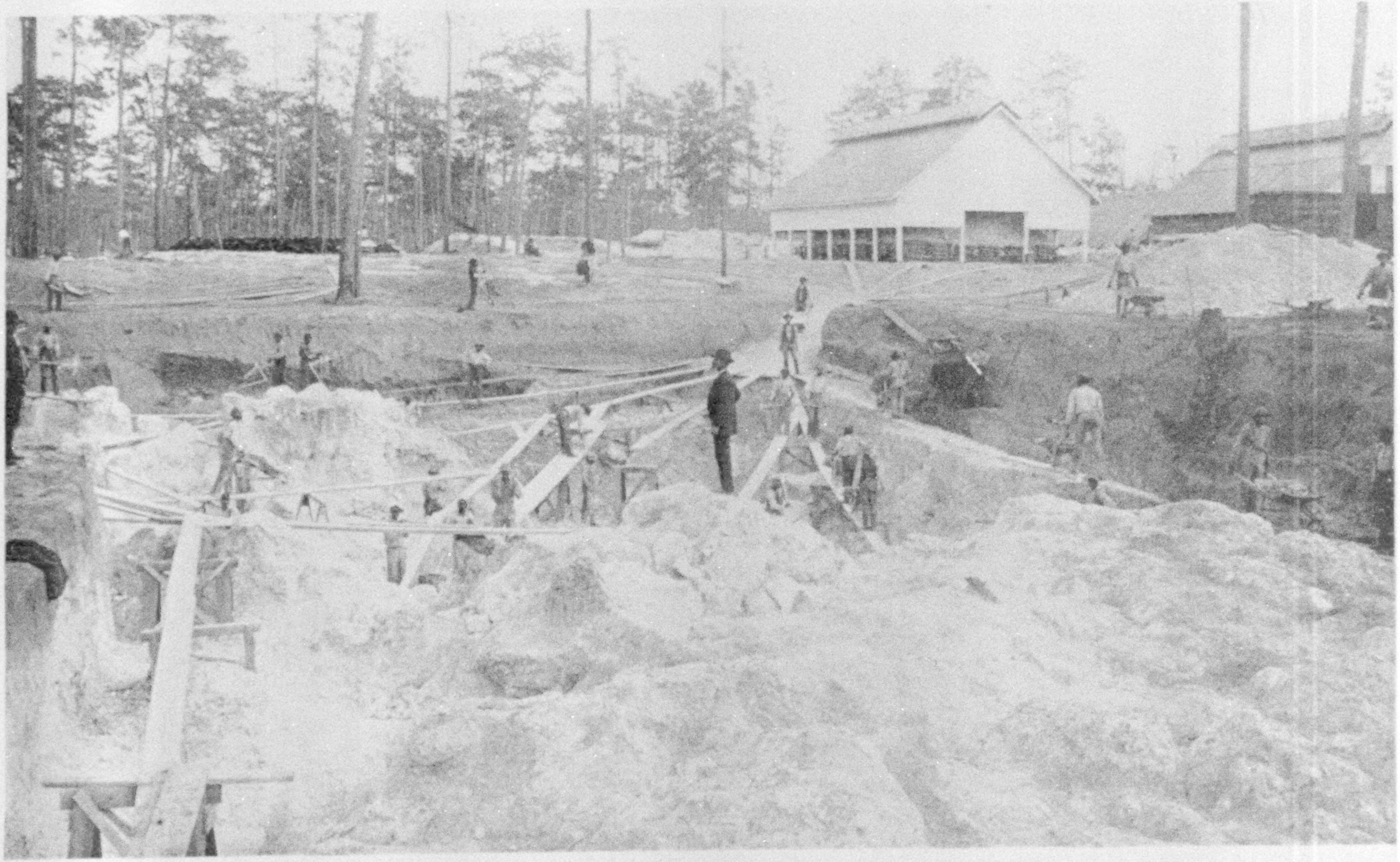
I am not satisfied with the operation of the homestead law as to the timber lands of the far western lands. As the law now is, a man may enter upon 160 acres of these lands, and by living a total of 21 months on the land during three years and cultivating at a maximum 20 acres of the land it becomes his. He promptly proceeds, if he is wise, to sell it to some lumber company for from $10,000 to $20,000. The land is allowed to lie for an indefinite period as a part of the company's forest reserve or is logged off, leaving the stumps in the land, and eventually sold for agricultural purposes, if so adapted.

Experience justifies the statement that few men take up these heavily timbered lands under a bona fide attempt to meet the purpose of the law, which, as its name implies, is to convert the public land into homes. By the investment of a few months' time and a few hundred dollars the homesteader gains a property worth many thousands of dollars. Yet all the conditions of the law are complied with and patent must issue. The government loses the timber and the land and does not gain a real home-maker. Such homesteaders add nothing to the wealth of the nation. The law should punish them, in fact, as frauds. Whether with the connivance of the lumber companies or not, they are the agencies by which the law is defeated and the lands conveyed where it is not intended that they should go.

There is a remedy for this condition of things, and it lies in the selling of the land and the timber separately. I am beginning to doubt the wisdom of applying the homestead law to any land which has not first been declared fitted for agriculture. It is now a blanket law which is used to cover a multitude of frauds. Such legislation would also cure the abuses resulting from the use of certain classes of scrip.

THE ARID LANDS OF THE GREAT AMERICAN DESERT

"The Great American Desert," as it was designated upon the map some 40



OPEN PIT PHOSPHATE MINE IN FLORIDA

Photo from U. S. Geological Survey

"We have millions of acres of phosphate lands which are estimated to contain several billion tons of phosphate rock, undoubtedly the world's largest known reserve. In 1910 the United States produced 52 per cent of the world's output of phosphate rock, and last year over 40 per cent of our product was exported" (see page 204).

years ago, has become one of the richest portions of our country. This desert included a variable area, generally all west of the Missouri River to the Sierra Nevada. Today it is harvest field, cattle range, mining camp, and orchard—where there is water. And where there is no water it remains desert.

There are at least four States which can never increase greatly in stable population unless their lands are brought under irrigation. And in all of the Western States there are tens of thousands and in some millions of acres that will remain waste land, fit only for the poorest cattle range, and much not even for that use, without the expenditure of large sums for reservoirs, dams, canals, and ditches.

That there is not water enough even with the fullest storage to supply the demands of all the arable land can safely be said. That, however, there is sufficient to care for a large part of this territory and bring it into fruitfulness there is no doubt.

The government, seeing this condition, undertook to lend itself to the development of these lands by what is known as the Carey act. This was a form of coöperative effort in which the Federal government turned over any required body of lands to a State, which the latter undertook through private enterprise to irrigate. When to irrigate meant nothing more than to divert a portion of a stream from its bed and convey it by gravity to the desert, this plan was attractive. But since these simpler methods had to be abandoned as no longer adequate, this act has done little in the promotion of such enterprise.

The successful Carey act projects are a distinguished few. Great wrongs to trustful or none-too-wise farmers were done in its name, and the suffering which it caused has made it difficult to make it serviceable, even under the more careful scrutiny of later and more cautious officials.

THE GOVERNMENT'S RECLAMATION WORK IS A SUCCESS

Because of the magnitude of the money investment required, and appreciative of the need, Congress in 1902 adopted the policy of undertaking irrigation projects of its own. The moneys received from the sale of public lands—less 5 per cent—went into a reclamation fund, administered by the Department of the Interior. The result has been the construction of some 25 projects, scattered through all of the arid-land States. In these the government has invested approximately $76,000,000. One of these, a pumping plant in Kansas, is now unused; another, a flood-storage system in New Mexico, is only in partial use; both of these, however, represent less than 1 per cent of the total investment. The others are in operation, and less than 3 per cent of all the land which is served or which we are ready to serve is unoccupied. This work has been a success.

Soon after taking office I received a number of letters complaining of the reclamation service. To inquire into these complaints I first called a conference in Washington of representatives from all the projects and later visited most of those from which most serious complaint had been received. I cannot here review the matters considered or the information gained. My conclusion was that mistakes had been made by the service, some of which grew out of ambiguities or defects in the law, some out of inexperience, and others out of a misconception of the relationship that should exist between such a governmental service and those with whom it was dealing. A larger degree of frankness with the farmer on our part and a fuller appreciation of the responsibilities assumed on the part of the farmer will mend much of the feeling that I found.

RELIEF FOR THE USERS OF WATER RIGHTS

But there is one matter of great moment to these people which should be corrected by law as soon as possible. We mistook the ability of the farmer to pay for his water rights. Ten years was the time given. His optimism and our own was too great. That time should be doubled. This should be done not alone because of the inability of many to meet their obligations to the government, but because it will prove wise policy to give

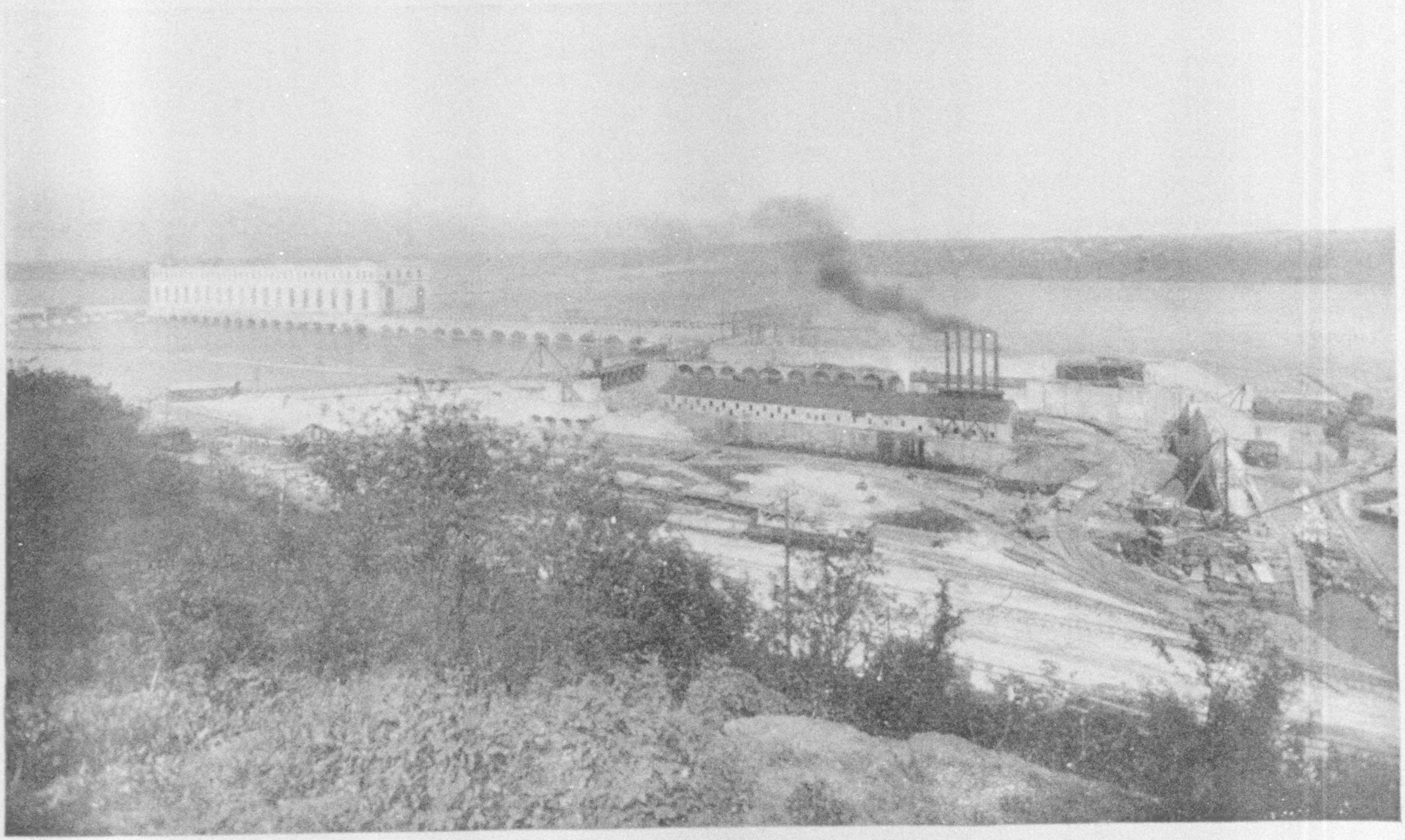
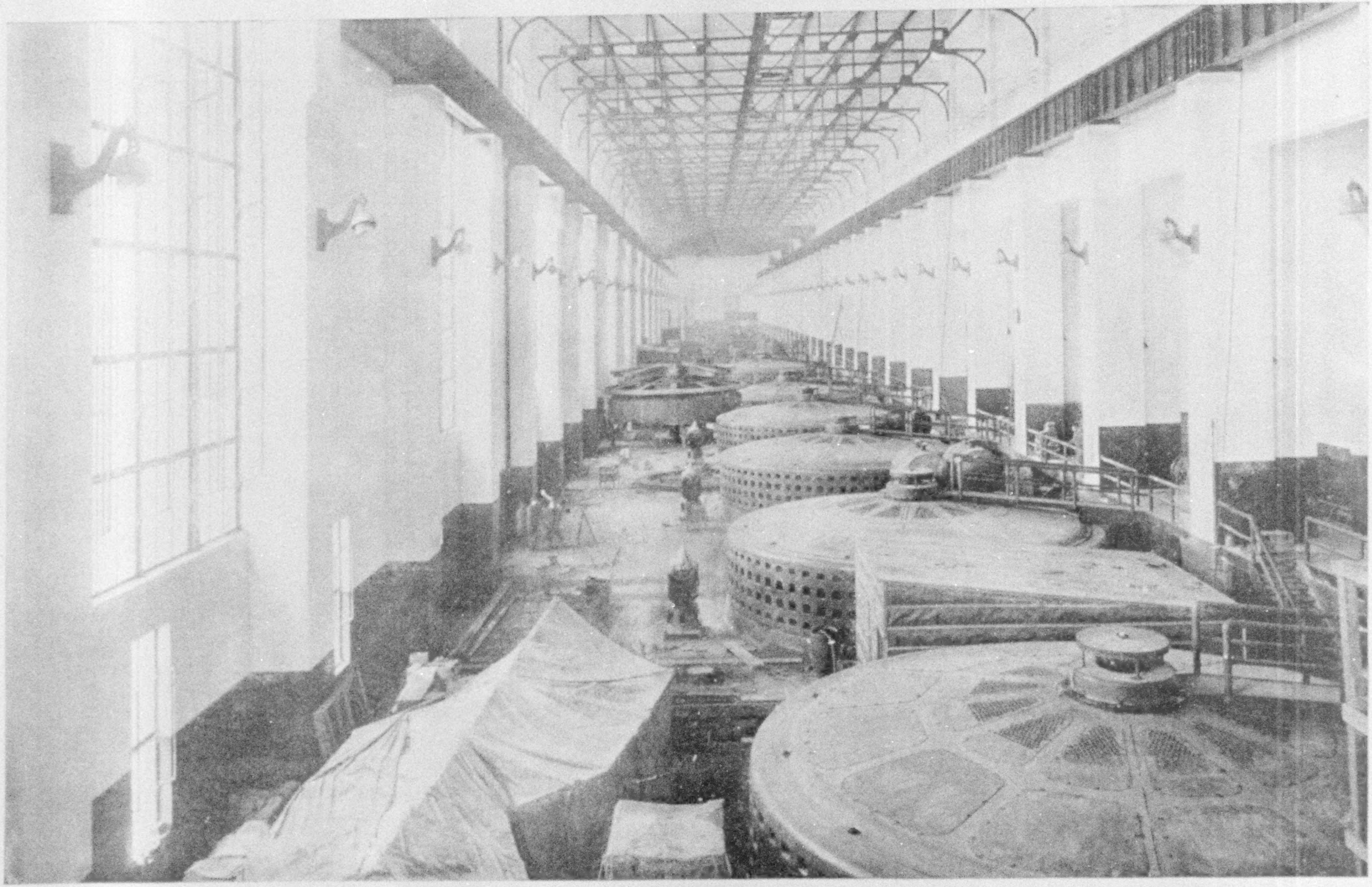


Photo by Anschutz

THE GREAT MISSISSIPPI POWER DAM AT KEOKUK

This great dam across the Mississippi forms the largest water-power plant in the world. It is nine-tenths of a mile in length, while the power-house is a third of a mile long, half a city block wide, and as high as a 15-story skyscraper. Over $27,000,000 have been spent in the construction of this plant, which will produce 310,408 mechanical horsepower, at least two-thirds of which will be available for manufacturing purposes. Each horsepower developed in a manufacturing community eventually supports five persons, so that it is estimated this new dam will support one million new inhabitants within a radius of 150 miles of Keokuk.



THE GENERATORS OF THE LARGEST WATER-POWER PLANT IN THE WORLD

Photo from Anschutz

The picture shows part of the row of 30 electric generators in the power-house at Keokuk. Through these generators the flowing stream of the Mississippi is converted into heat and light. From them electric power will be sent to St. Louis, 137 miles distant, where it can enter into successful competition with the cheapest coal and the cheapest steam power in the United States.

a free period within which the farmers may more fully use their farms. They can put their lands to a more profitable use, both to themselves and to the country, by being allowed to cumulate their earnings in the early years and be thus enabled to make investments in stock and machinery which will make for larger profits later.

I feel the keenest sympathy with those upon these projects who are entering into this work of putting the desert into public service. They are genuine pioneers in a new field of work, on the success of which depends greatly the rescuing of a vast territory. The enemy of the government and of the farmer is the land speculator. He is of two kinds. Sometimes he is a farmer who does not expect to farm but to sell out at a higher price and go elsewhere. Generally, however, he is the holder of a large tract of private land within the project, who creates false values and burdens those who buy and attempt to farm with a load of debt which handicaps them in their efforts. Both of these are hostile to the welfare of the enterprise and tend to destroy the value of the service which the government is attempting. But such matters may, I trust, be overcome by new methods of administration.

It is my hope that the government will find its way to enter with zest upon more works of a similar character. Not to do this will leave undeveloped much of the most fertile land of the West. What is to be the future of Arizona and of New Mexico, of Nevada and Utah, of southern Idaho, central Oregon, eastern Washington, much of Montana and Colorado, and more of Wyoming and Nebraska, if the government does not aid in their development?

Private capital will not, for many years at least, risk undertakings of such magnitude as these States require. Experience has made the irrigation-bond buyer extremely wary. Within a few weeks the most promising of the great private enterprises in Idaho has met with the misfortune which had befallen so many others in neighboring States. The most successful irrigation plants are founded on the wrecks of their pioneer exploiters. The government has rescued others.

It has been with these projects much as it has been with our western railroads. They had to descend into the hands of the receiver before they could be resurrected into a new and glorified life.

THERE IS MUCH MORE IRRIGATION WORK FOR THE GOVERNMENT TO DO

But where are the funds to come from to carry on such work? My answer is, From the public lands in these States. We sell these lands now and the proceeds go into the reclamation fund. This is the policy of Congress—that we shall for a time use the moneys which the government derives from the sale of its lands to create new values within the States. Two years ago the government went further and set aside $20,000,000, to be used in the completion of the irrigation schemes now under way. This is an advance by the government for which it takes what might be termed a mortgage on the moneys which the projects will yield from the sale of water rights. Why not extend this policy?

The West can use profitably and wisely $100,000,000 in the next 10 years to the advantage of the whole country. Indeed, without this expenditure the asset which the government has in its desert lands will lie unused and be of no national value. The government will recover all of the money it advances, not to speak of the homes and the values created by its enterprise.

If the government will place upon a leasing basis these western resources with which we have been dealing, it can have an increased fund for the continuance of this work and an increased assurance of the return of its advances. Just as I would aim to make Alaska pay in the end out of her own resources for a liberal advance made to her for the opening and improvement of her territory, so should we aim to make these lands of the West bring into being the latent values of the West. With a little foresight we can transform coal and oil, phosphate and timber, into green fields and electric power.

Railroads and power plants, street railways and waterworks, are built with 50-year bonds, which rest upon the foundation of their probable earnings.

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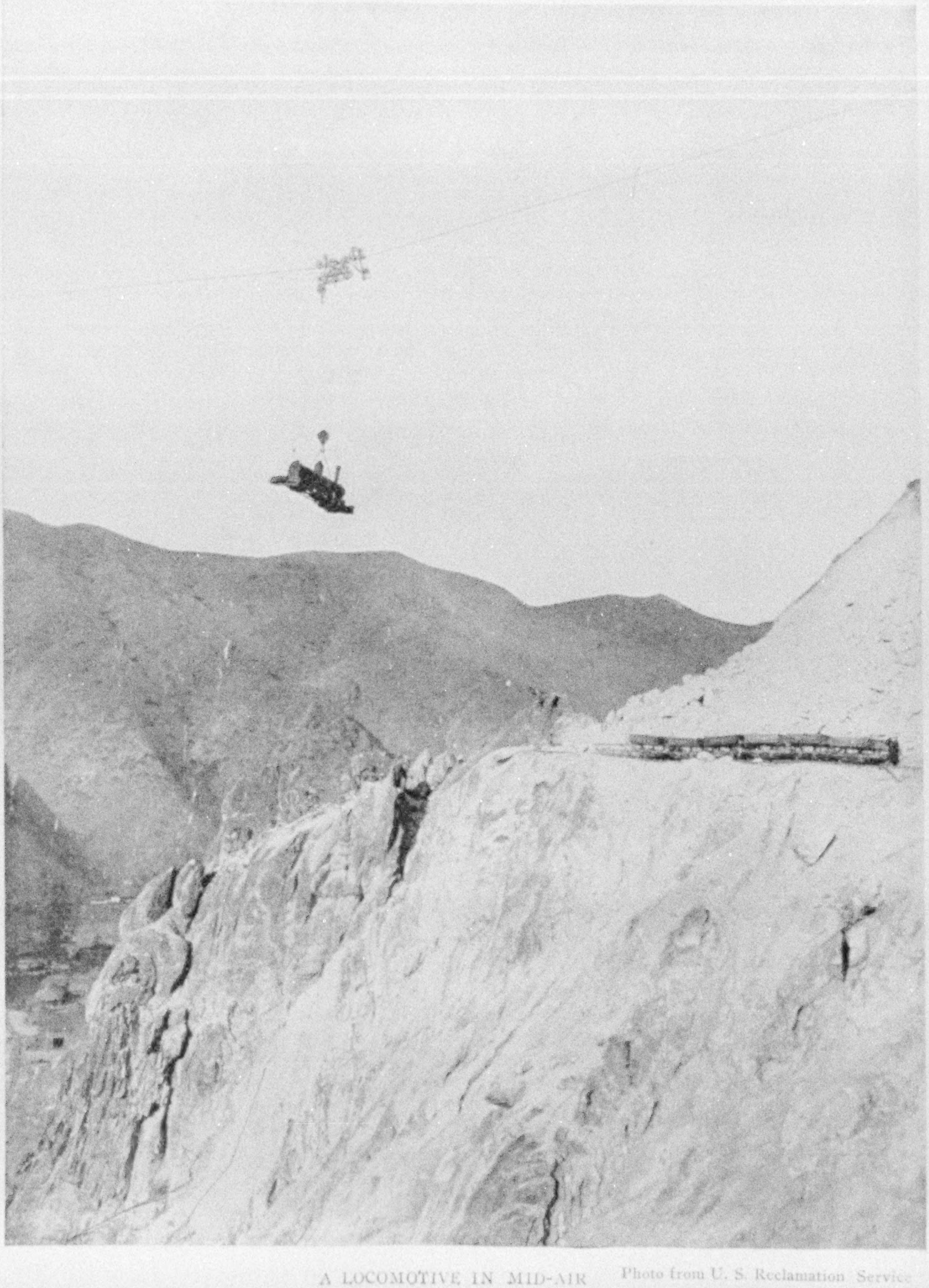

A LOCOMOTIVE IN MID-AIR Photo from U. S. Reclamation Service

Moving an engine from the bottom of the site of the Arrowrock Dam in Idaho to the top of the future spillway, 350 feet above. The Arrowrock Dam, which is part of the Boise Reclamation Project, will be the highest dam in the world.

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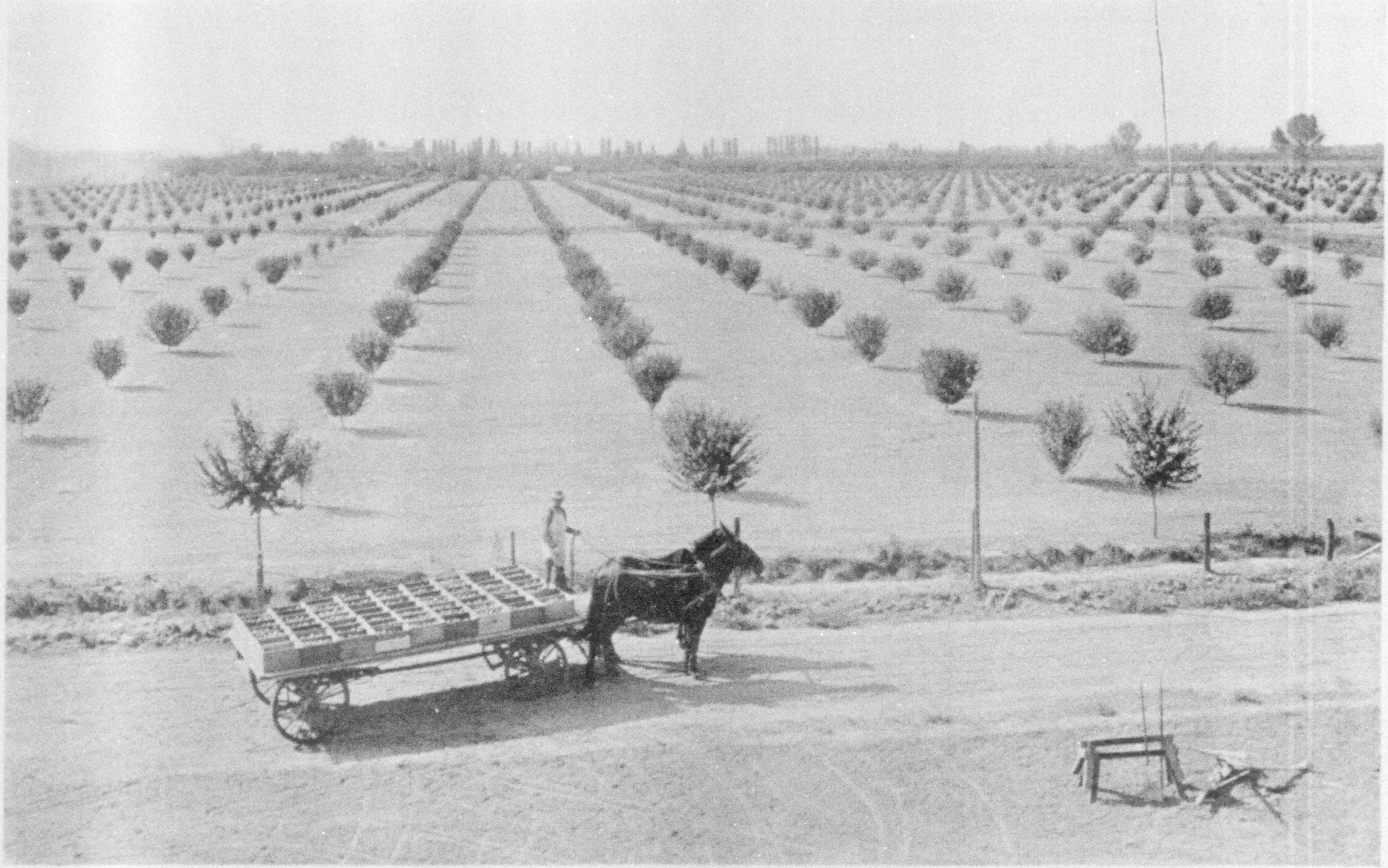


GROWING APPLES IN THE DESERT

Photo from U. S. Reclamation Service

This thriving young apple orchard is growing on what a few years ago was part of the desert plain of Idaho. This transformation is due to the water furnished by the Boise Project of the U. S. Reclamation Service, upon which the government has spent more than eight million dollars. Ninety-seven per cent of all the land which is served by the government reclamation projects, or which is ready to be thus served, is occupied (see page 209).

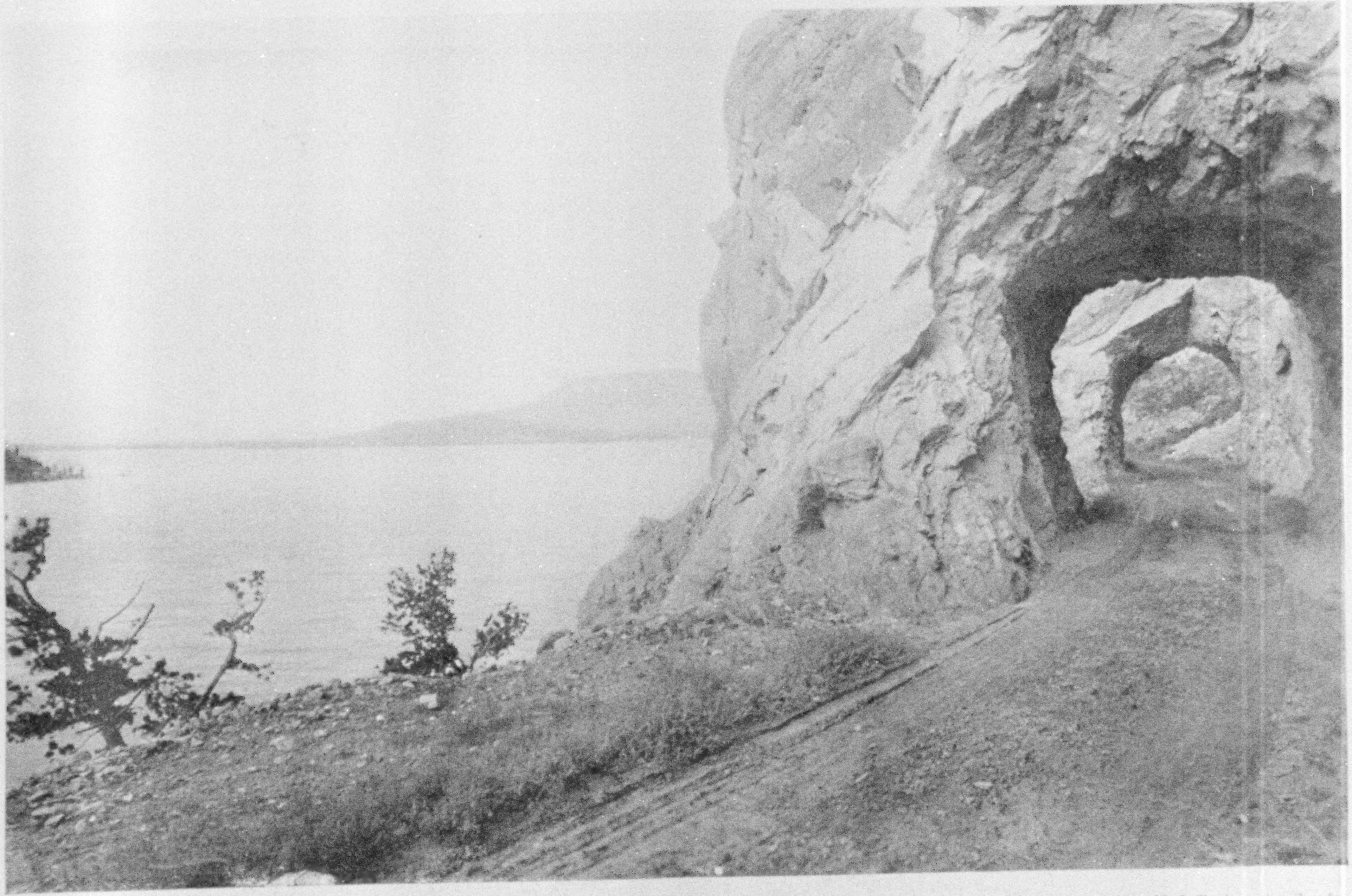


Photo from U. S. Reclamation Service

THE GREAT GOVERNMENT RESERVOIR AND TWIN TUNNELS, THREE-QUARTERS OF A MILE FROM THE SHOSHONE DAM, WYOMING

"Stored water means more than fields of alfalfa, generous orchards, and the homes of hearty husbandmen; it means power for industries, light and heat for town and farm. These two—irrigation and hydro-electric power—are companions. One does not think of the one without suggesting the other. And the magic worked by each is rivaled by its mate" (see text, page 219).

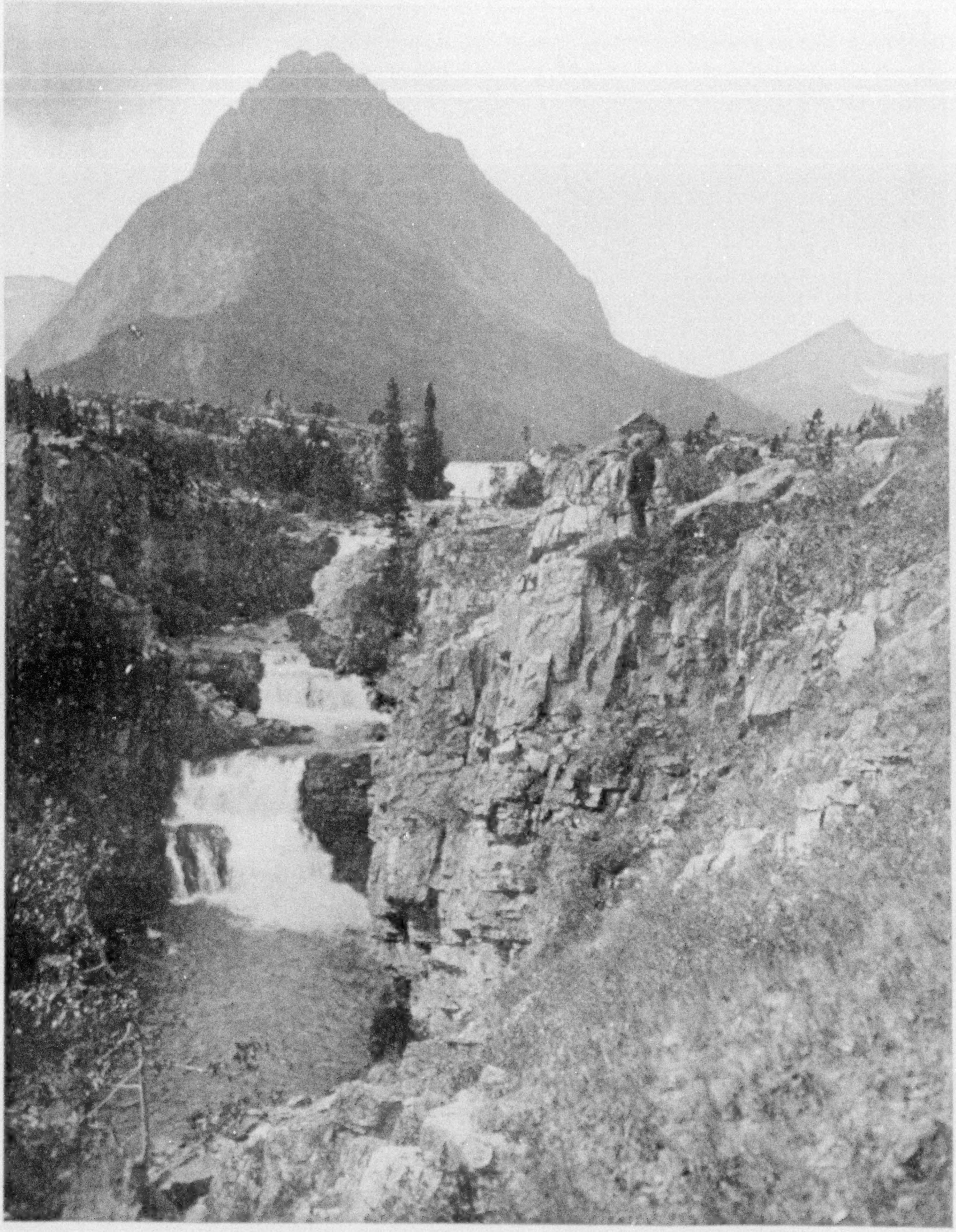
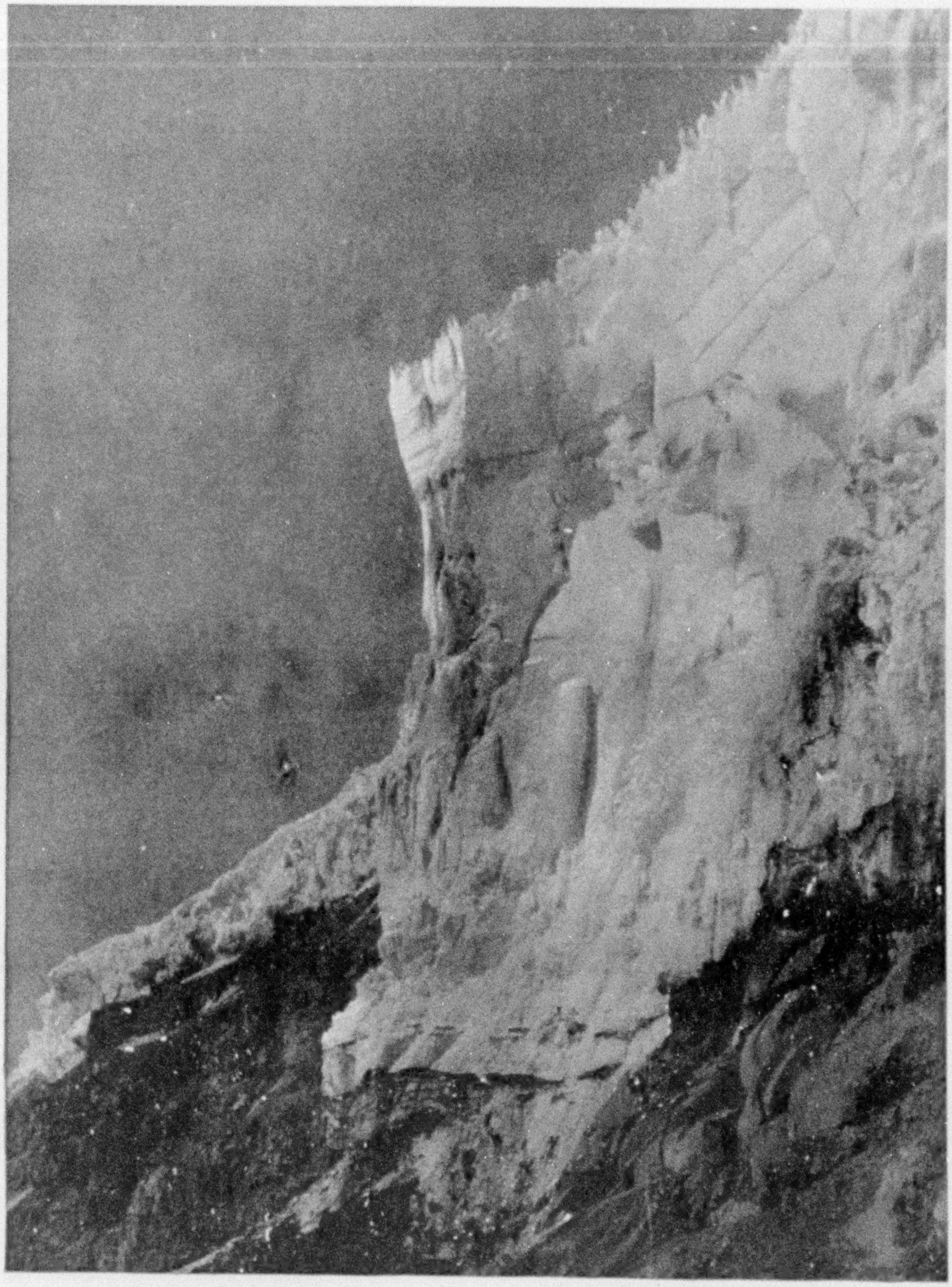


Photo from U. S. Reclamation Service

THE MCDERMOTT LAKE AND FALLS, MONTANA

The dam of the St. Mary Project of the Reclamation Service will be built across the canyon at the foot of the falls shown in the picture. While it will destroy the beauty of these picturesque falls, it will be the means of bringing under cultivation great tracts of land which are now arid.



AN ICE WALL ON MOUNT RAINIER

Photo by A. H. Barnes

This great ice wall, with its face of 400 feet, stands on the upper part of the mountain. Mount Rainier, the Great White Monarch of the Pacific Northwest, is included in the Mount Rainier National Park and is one of the wards of the Secretary of the Interior.

CALIFORNIA INDIAN MOTHER AND HER BABIES

California has an Indian population of over 16,000, who are looked after by the office of Indian Affairs of the Department of the Interior. The Indian Service has some 6,000 employees distributed over twenty-six States, and it administers one billion dollars' worth of property which belongs to the various Indian tribes.

It is not without precedent in principle or in fact for the United States to improve its own property and for its advances take a mortgage upon the wealth it creates, and in one-half of 50 years we would regain our capital.

Inasmuch as the title to these oil and other lands would remain in the government and be excluded from State taxation, it would seem to be fair that a certain percentage of the royalties received should go to the States within which the revenues are raised. Twenty-five per cent might be a minimum, but a higher percentage would seem advisable if the whole might remain for a time in the government's hands to be used in such coöperative irrigation enterprises as the State might desire, and after such use has been made and the fund replenished, be fully released to the State.

COÖPERATION OF THE FEDERAL GOVERNMENT WITH THE STATES

This suggestion of coöperation with the State is not made idly. I look forward with confidence to a more intimate relationship between the States and the Federal government in undertaking this work of developing the West. The mass of the people are sympathetic with the purposes of the government. They regard with pride the great engineering works of this service, which stand as monuments to the interest of the nation in their welfare.

So cordial, indeed, is the spirit of the West toward this work that within a few months the State government of Oregon and the Federal government, through the Reclamation Service, have become partners in several projected irrigation plans, one involving no less than the pumping of water from the Columbia River by electric power generated by the river itself. A similar coöperative enterprise has been entered upon with the State of Washington.

The plan is that we shall do the work, supplying one-half the funds and the State one-half. This is a tendency which it is well to foster; for the State will well appreciate the effort of the nation when it makes like sacrifice itself. And nothing could more induce to the success of the nation's effort than to have some local check and interest. To place at a State's service a large sum gathered from the resources of the public lands within her borders would enable this character of mutual effort to expand.

This can be done if we will retain for national improvement a portion of the national resources. And this may be done, I believe, with the hearty good will of the people who are chiefly concerned—the people of the West.

One reason stands out demanding the promptest possible action in this matter. Reservoir sites are few and becoming fewer each succeeding year. Those that may be had are rising steadily in value. So valuable, indeed, have some sites become since the institution of the Reclamation Service that projected enterprises are not now regarded as feasible, for the dependent lands which it was intended to irrigate can not make a return sufficient to pay the increased cost.

And let this not be forgotten, that stored water means more than fields of alfalfa, generous orchards, and the homes of hearty husbandmen; it means power for industries, light and heat for town and farm. These two—irrigation and hydro-electric power—are companions. One does not think of the one without suggesting the other. And the magic worked by each is rivaled by its mate. Electricity is coal and kerosene which need no railroad to transport them. The significance of these irrigation reservoirs from this point of view is but beginning to be appreciated and will grow greater as the country becomes more thickly populated and factories come to supplement the farms.

THE ENORMOUS VALUE OF POWER SITES

And this brings me to the consideration of the government's policy toward the use of the public lands for reservoir and dam sites. It is one of the most perplexing problems that engages the mind of the man who wishes to see the West thrive more abundantly. What is such land worth? Are we justified in measuring its value by the use to which it is put, or should we yield this strategic resource without compensation?

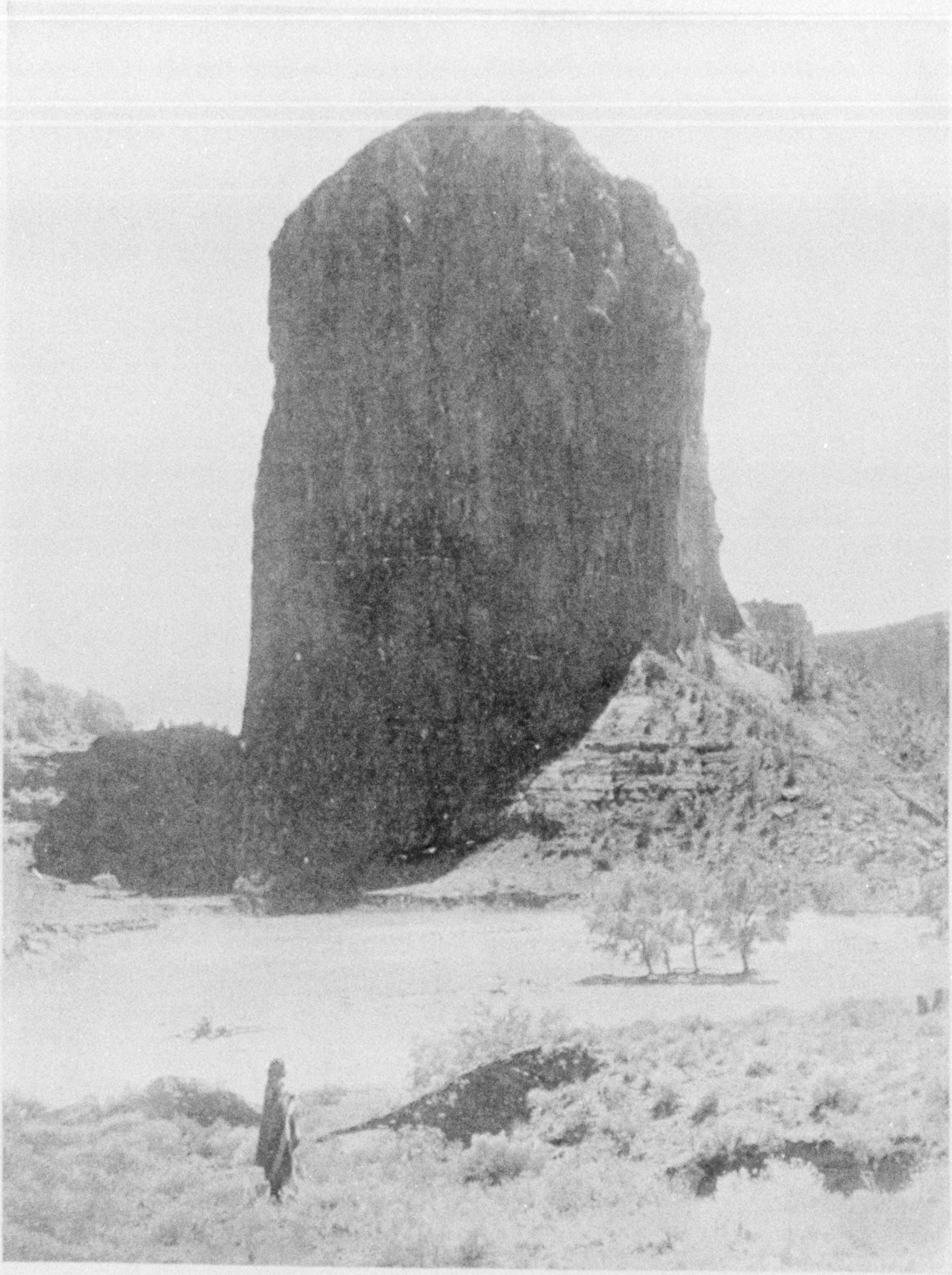
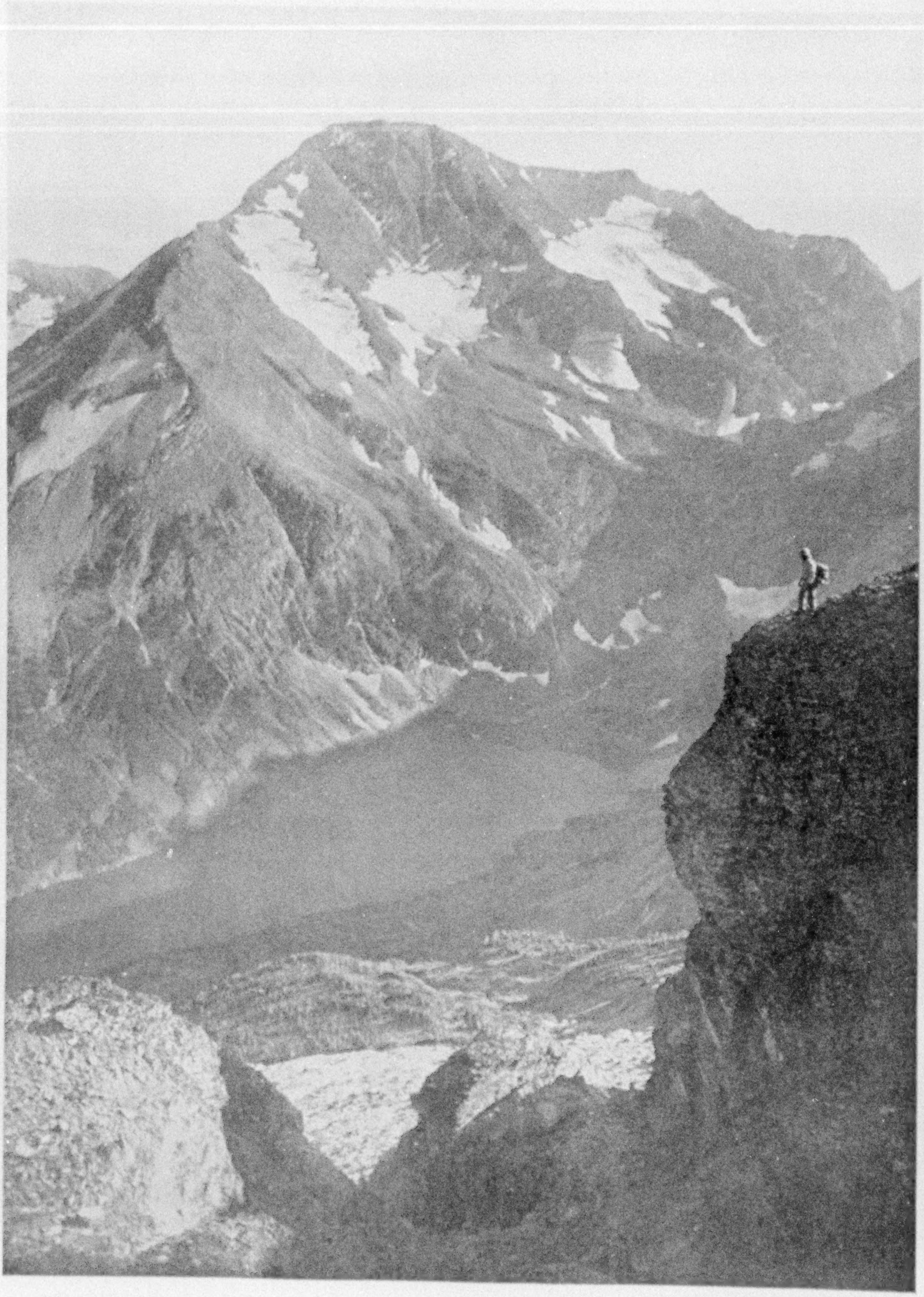


Photo by George R. King

ONE OF OUR NATIONAL MONUMENTS

This towering mass, known as Monument Rock, stands in the Canyon de Chelley in Navajo County, Arizona, within an Indian reservation. It forms part of a collection of natural wonders situated in an area of 360 acres which were declared National Monuments in 1912, and, as such, are preserved by the Department of the Interior.



GUNSIGHT LAKE FROM MOUNT JACKSON Copyright, Kiser Photo Co.

One of the beauty spots in Glacier National Park, Montana. The national parks are under the jurisdiction of the Secretary of the Interior, who is charged with the duty of preserving the wonders of Nature contained in them from desecration. Glacier National Park contains over 900,000 acres and is the youngest of our twelve parks.

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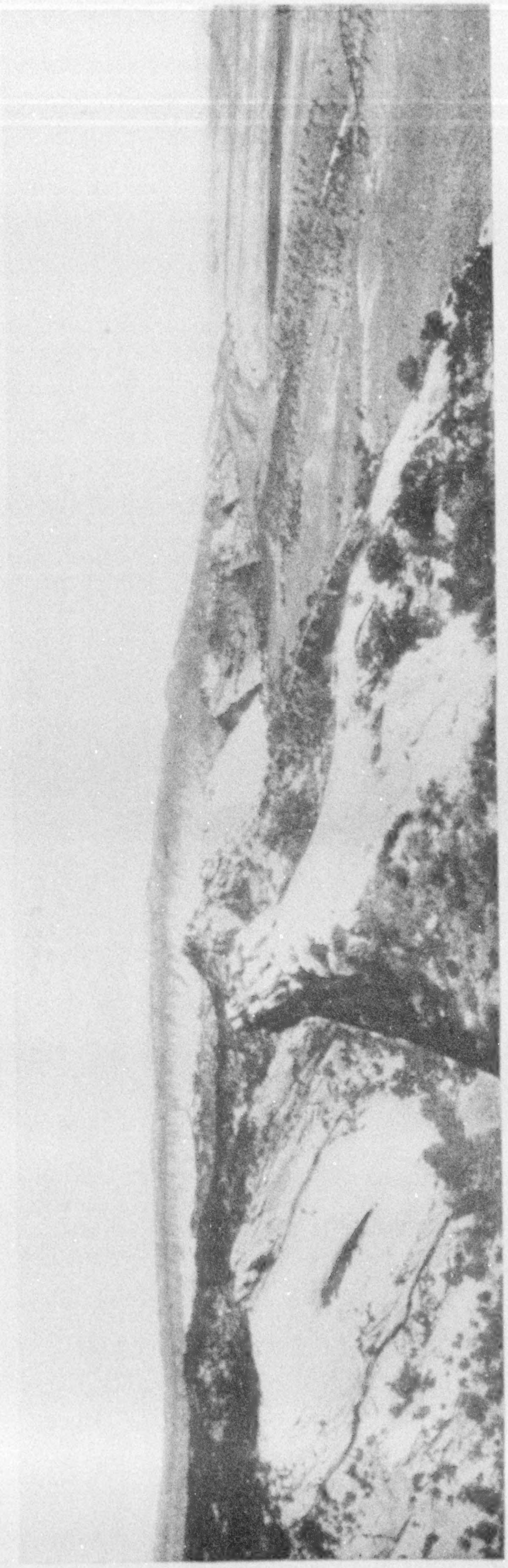


A SCENE IN A CHARACTERISTIC RADIUM-BEARING COUNTRY IN COLORADO   Photo from U. S. Geological Survey

The ridges are of white sandstone, containing the carnotite ores from which radium is extracted. The Secretary of the Interior, Mr. Lane, has recommended that the President be empowered by Congress to withdraw from the public domain lands containing carnotite, pitchblende, or other minerals or ores from which radium may be derived. The law at present does not permit the withdrawal of mineral lands except coal, oil, potash, and phosphate lands.

The country has been aroused too late to save the very richest of these points of vantage. Private power companies hold the most accessible of these sites under rights of which they can never be deprived.

So much more compelling the reason why we should not yield what remain unwisely. The temptation to grant generously without condition that which may be put to so beneficent a use must be resisted if we are not to meet a spendthrift's fate. At the same time there must surely be a rational way by which capital may be brought into this public service. The present condition of stagnation does no one good. Within a generation I believe the people will be as alive to the value of public ownership of hydro-electric power plants as they are today to municipally-owned waterworks.

The people not being prepared, however, to proceed to put these lands to their highest use, I am not in favor of keeping them from being utilized by private capital in the public interest. Because we do not know what is best to be done is not a reason either for doing nothing or for getting rid of the trouble as soon as possible, on the old "land-island" policy.

How may the needed advantage be gained for the present and the needs of the future be cared for? This is the immediate problem. What may capital reasonably demand? A fair and attractive return upon its investment yearly and the full return of its capital. And what may the public served reasonably require? Good service and fair rates. Who

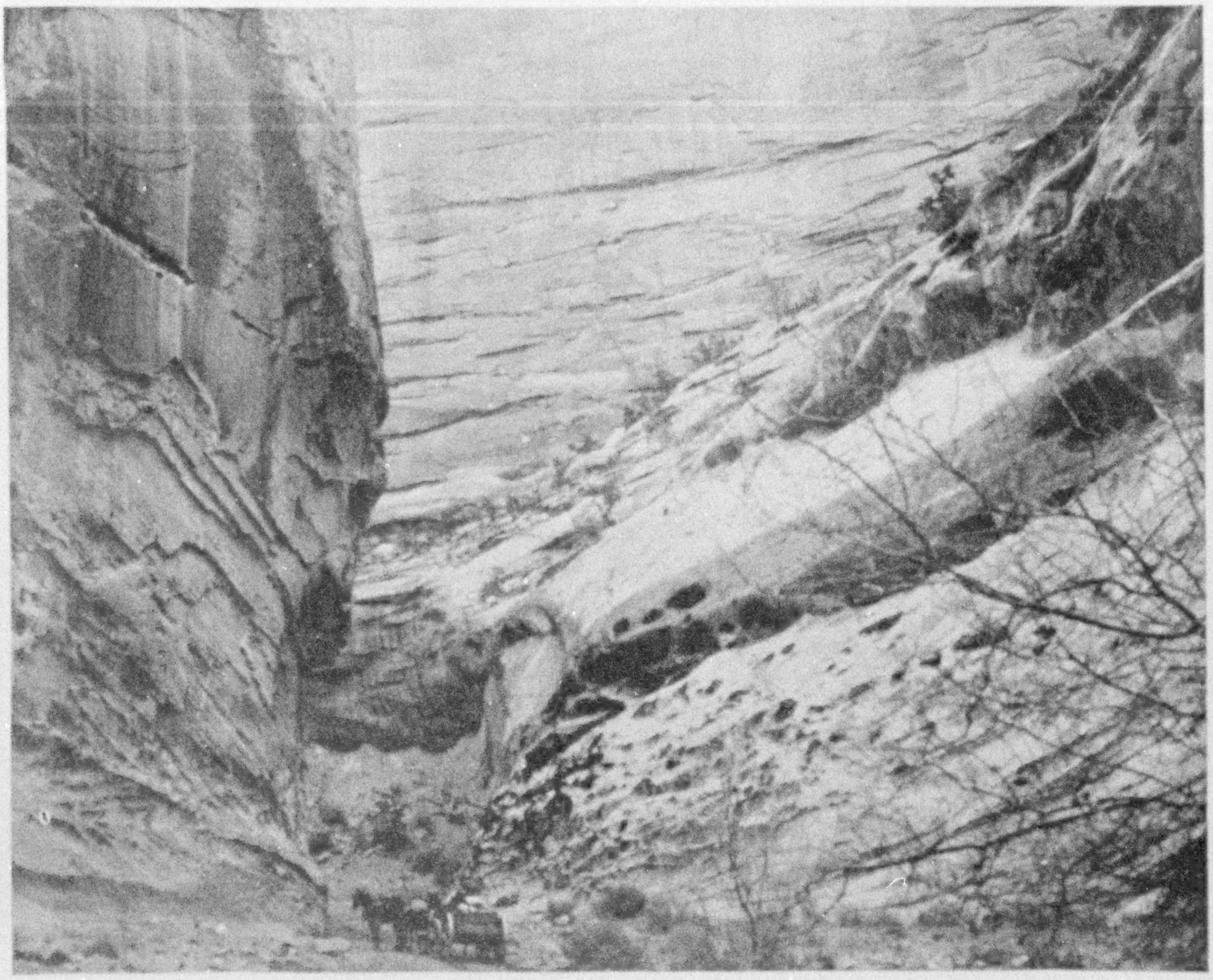


Photo from U. S. Geological Survey

IN THE RADIUM COUNTRY: COLORADO

The greater part of the world's supply of radium is obtained from radium-bearing ore mined in the United States. At present the ore is exported to Europe, where, in the laboratories of France, Austria, Germany, and England, the radium is extracted from it. There appears to be in the United States today less than two grams of radium—that is, less than one-fourteenth of an ounce. This is valued at $120,000 a gram. Thus while we are supplying the world with radium, we have practically none at home, as heretofore no steps have been taken to preserve for our own people this invaluable metal.

shall make these rates? Within the State they must be subject to State regulation; between the States, Federal authority must control.

WHAT WILL THE GOVERNMENT RECEIVE FOR ITS LANDS?

What return shall the Federal government have for its lands? My answer would be, no return whatsoever, provided the plant reverted to the government without cost at the end of 50 or 60 years, or so much of the plant as was based on the land itself and the improvements directly attached thereto, such as reservoirs, dams, water rights, and rights of way. For the tangible property of the plant, such as the distributing system and machinery, the government might well agree to pay an appraised price, so as to insure its being maintained and extended during the later years of the life of the franchise.

The right to buy the complete plant at an appraised figure at any time after 20 years would be a further protection and one not burdensome, while for better service it would seem advisable that all plants be permitted, in fact encouraged, to combine physically, just as our railroads are required to couple themselves into through routes and thus make their

Photo from U. S. Bureau of Mines

IN A COLORADO RADIUM MINE

This picture shows the 4-foot stratum of radium-bearing ore, carnotite and vanadium in the Cliff Mine, Paradox Valley, Colorado. Radium is found in ores carrying uranium and vanadium, which are used extensively in the arts, and the processes by which it is extracted are secret. A process has been invented by the chemists in our Bureau of Mines which promises, from the laboratory experiments thus far made, to be successful. Under the endowment of two Americans, a building is now being erected in Denver (which, with its equipment, will be opened for work in the coming month) in which an effort will be made to prove the commercial possibility of this American process. If successful, this process will be given to the world, and all of the radium secured over and above a small minimum will be the property of the United States, and will be put into the hands of the United States Hospital Service for public use.

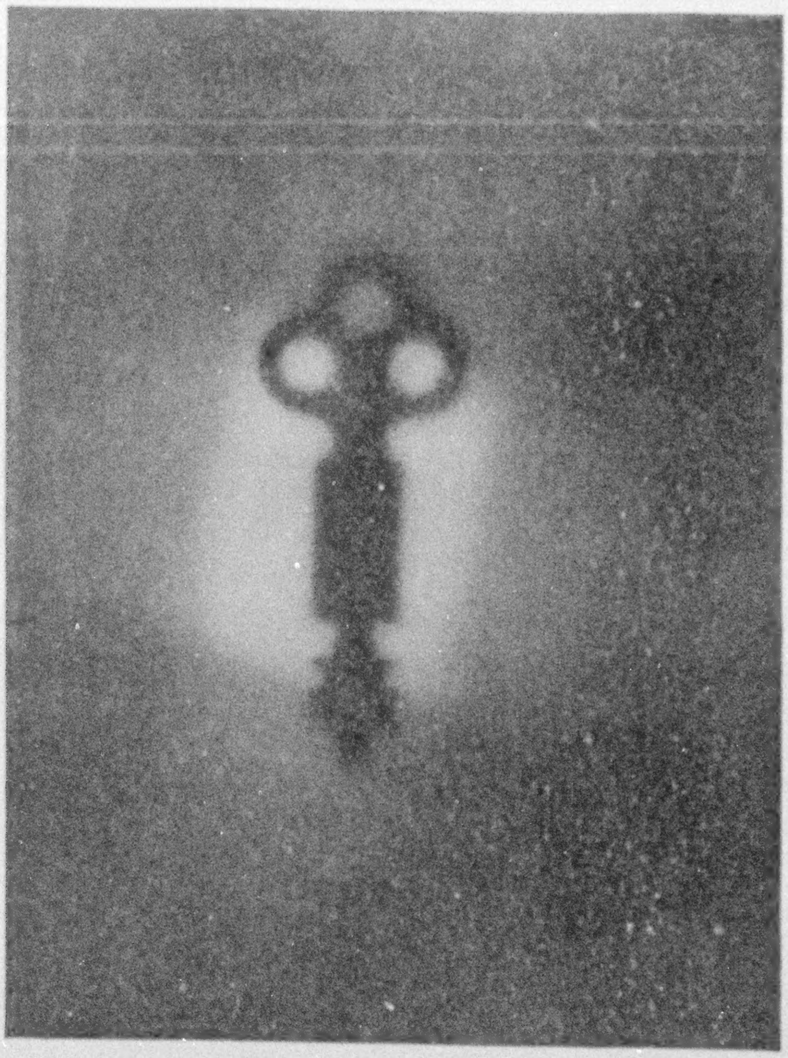
service continuous and interdependent; but they should not be allowed either to agree as to rates or to merge their capitalization or their identity.

Such plan as is here suggested should be attractive to capital wherever there is bona fide need for such water-power development, for it is definite in its terms and can be made a precise basis for capitalization. The term of the franchise would be long enough to permit of the amortization of the plant upon such a percentage as would lay no heavy burden upon each year's earnings.

Where a reservoir site is also used for the storage of irrigation waters, the right to which attaches to certain lands which should enjoy that use forever, it could be provided that at the end of the franchise period the government would either turn over the plant to the water users or the State or otherwise provide for its operation.

I have endeavored herein barely to outline such a constructive program as would meet any reasonable demand and with the least burden place our resources at the service of the people. It should not be impossible to hearten the hopes of those who live in Alaska or the many who would engage in her development were the doors of opportunity open to them. And if we can follow some such plan as has been suggested, by which, sensibly and conservatively, the resources of the West may be utilized for her upbuilding and improvement by the fullest recognition of their interdependence, I believe that we would meet the demands of all whose ambition to gain fortune has not closed their eyes to the general good.

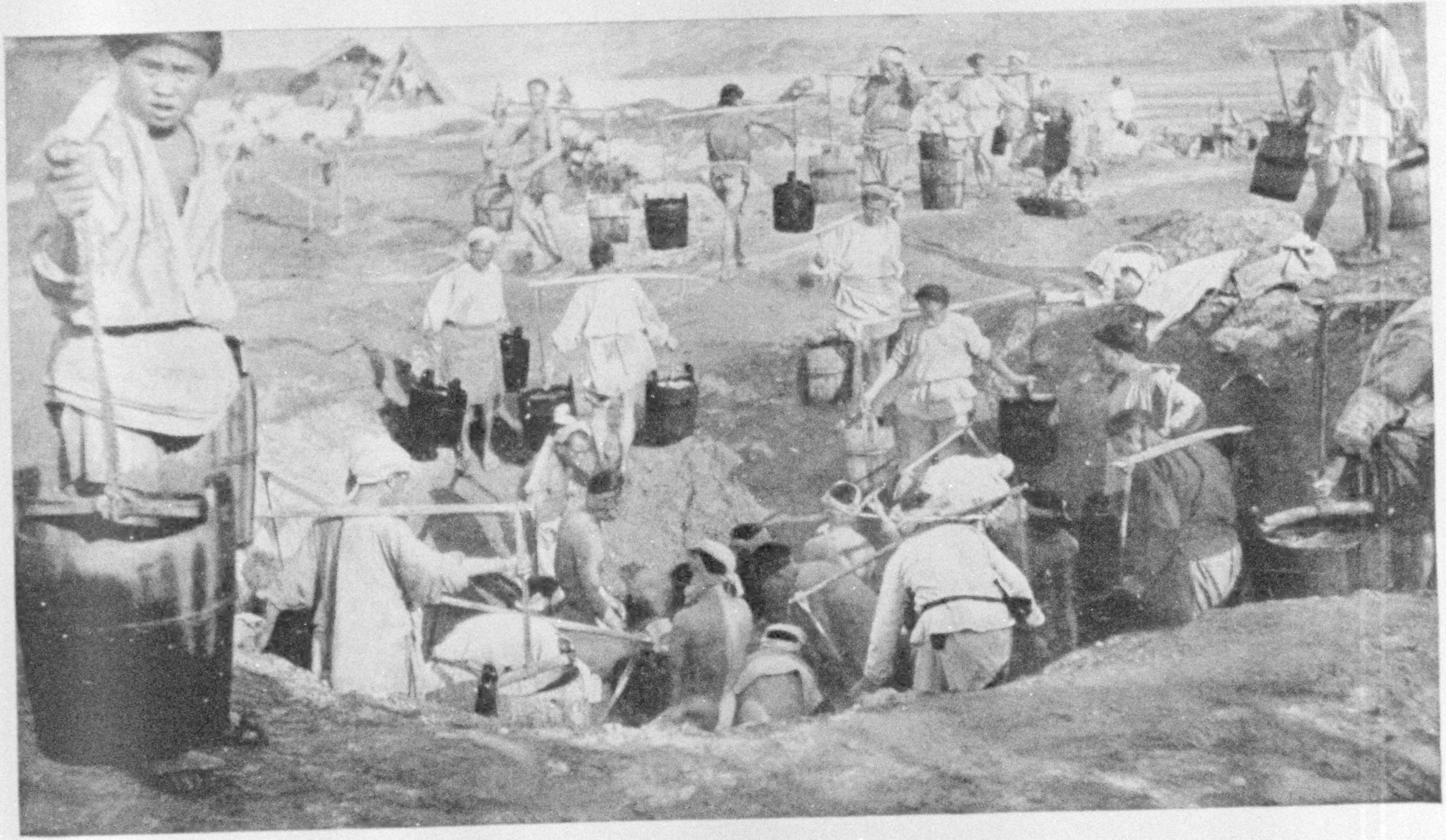
WHAT THE DEPARTMENT OF THE INTERIOR DOES EACH YEAR



A RADIOGRAPH OF A KEY

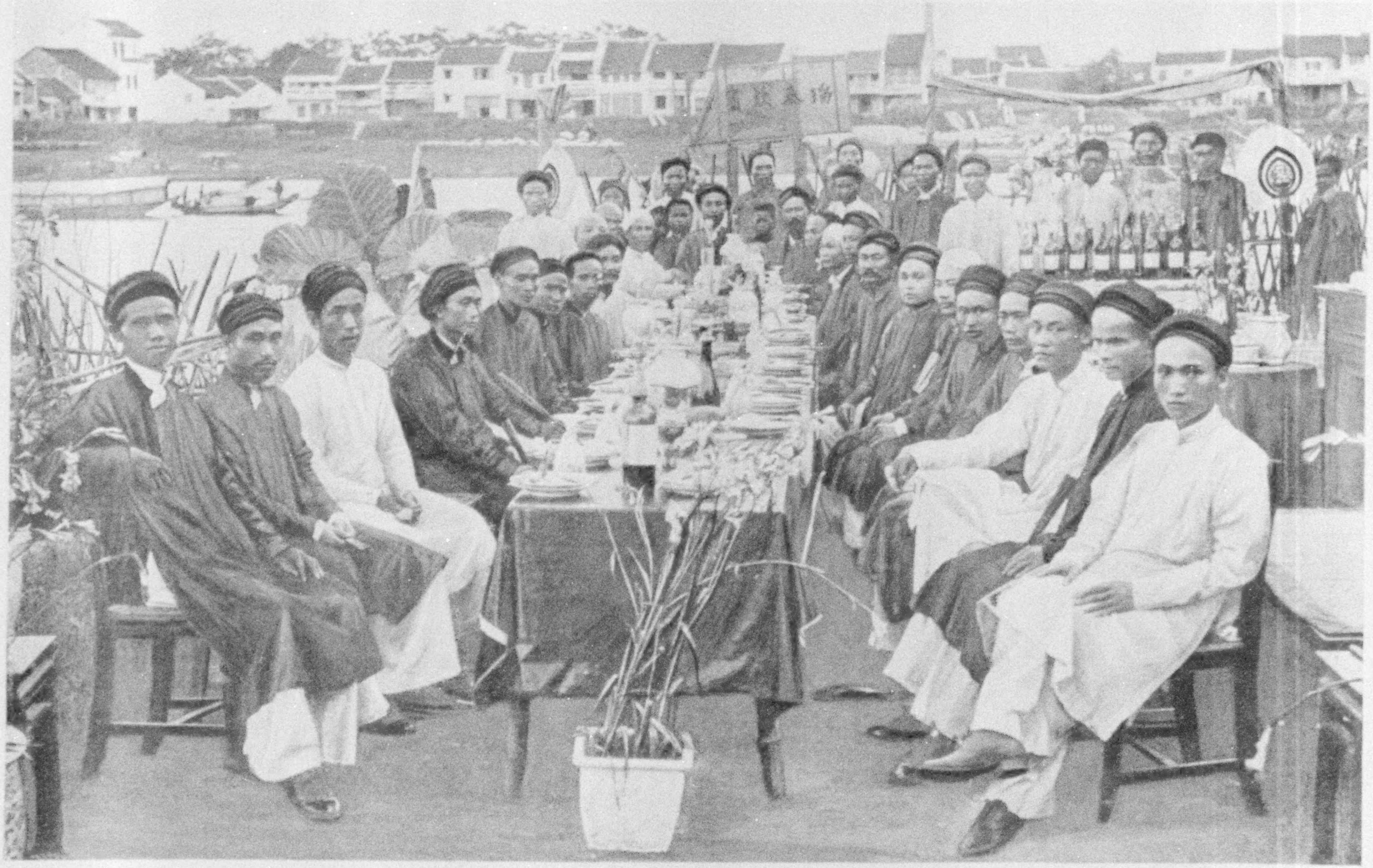
This picture was made by placing a key on the outside of a light-proof plate-holder containing a photographic plate. A block of radium-bearing ore three-quarters of an inch thick was then placed on the key and the photograph resulted.

The Department of the Interior has to do not alone with general policies, but with an infinitude of administrative detail. Its embarrasments arise out of the large number of matters as to which administrative discretion may be exercised. That you may, however, appreciate the scope of the department's activities, permit me to note here that we care for the Eskimo in Alaska and for the insane in the District of Columbia; for 324,000 Indians scattered throughout the continent, for whom we hold property in trust approximating in value $1,000,000,000; that the choice beauty spots of our country have been set aside as national parks, which are in our care; that we distribute to over 800,000 pensioners, their widows and dependents, a round sum of over $165,000,000 a year; that we issue to inventors of the United States and foreign countries an average of more than 3,000 patents each month; that every miner in the land is interested in those means which we are taking to prevent mine accidents and more fully to realize the mineral wealth of the land; that the schools of the Indians and the national university of the colored people are under our jurisdiction, together with the Hot Springs of Arkansas and the cliff dwellings of Colorado; that the internal economy of the Territory of Hawaii, as well as that of Alaska, fall within the purview of this department; that it is our part to measure the waters of a thousand streams, survey the lands of all the States, and look beneath the surface to see what they contain; that we have still in our care a great body of public land (some 300 million acres outside of Alaska), out of which each year approximately 60,000 farms are carved; that we have a bureau of education, which should be provided with the equipment by which it may adequately do a great work for the schools, the teachers, and the children of this country, or be abolished.



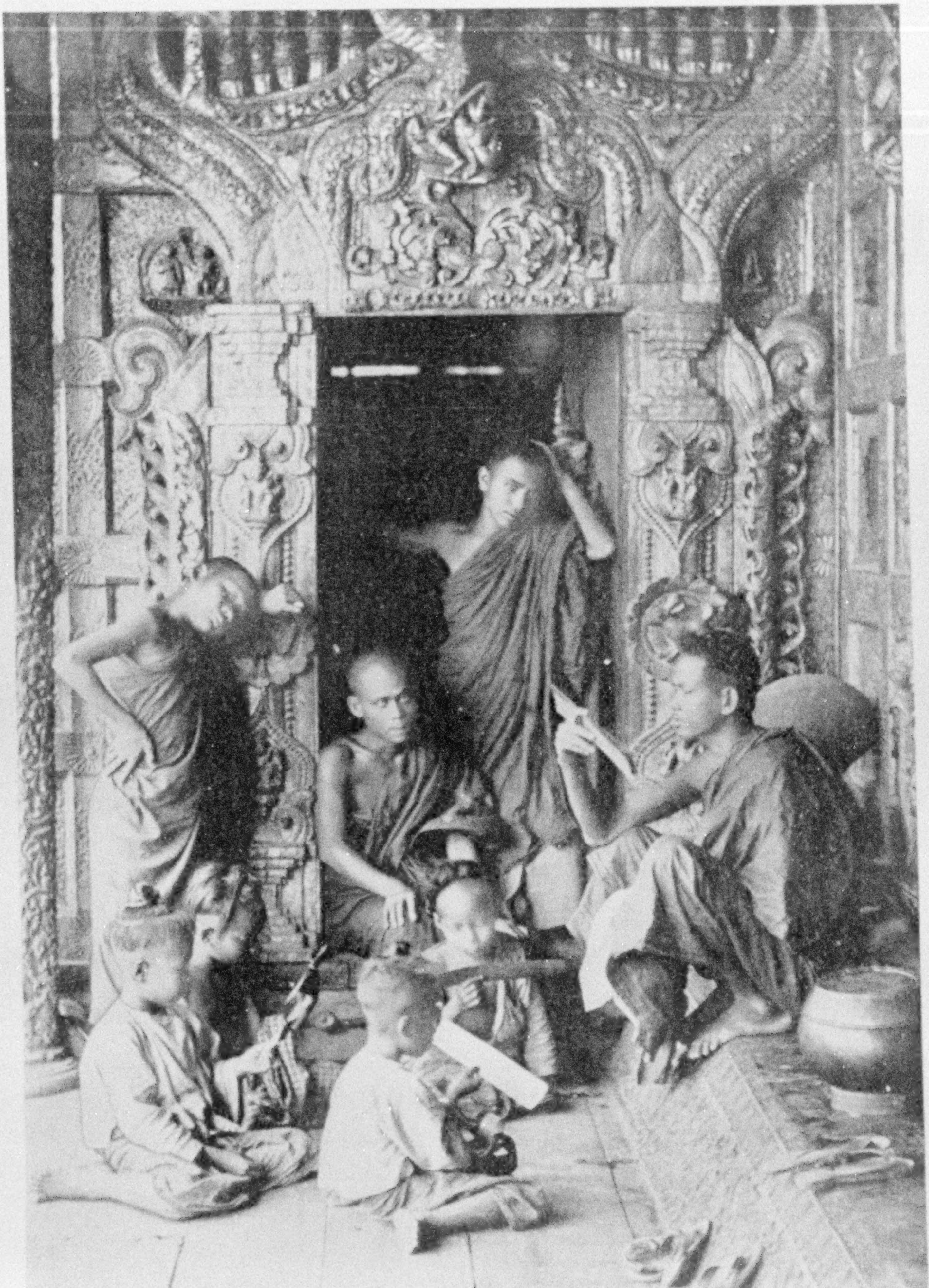
CHINESE SALT WORKS

Deposits of salt are very numerous in China and the production of commercial salt is a government monopoly. At the producing center the salt costs about three-eighths of a cent per pound, but when shipped by the government to the distributing centers it sells for eight and often ten times that amount. Hence the importance to China of the salt *gabelle,* as it is called.



AT THE COLLEGE OF INTERPRETERS, HA-NOI

The French, since their arrival in Tonkin in 1884, have pursued a very liberal educational policy. Primary schools have been established at convenient points, and a college of medicine for natives exists at Ha-noi, as well as the College of Interpreters, which is designed to give natives a thorough training in the French languages. The students are mainly Annamese, but there are also a few Chinese. The collegians live together during their course and it will be observed that at table they follow European customs.



AT STUDY IN A BUDDHIST MONASTERY Photo by Dr. W. E. Grubl

The children are studying the Buddhist Scriptures, which are written in a language called Pali on curious oblong tablets made of palm leaves. The monks are distinguished by their shaven heads and by their single garment, the famous yellow robe. In Burma all boys become monks for a year or two and in this way a part of their education is acquired.

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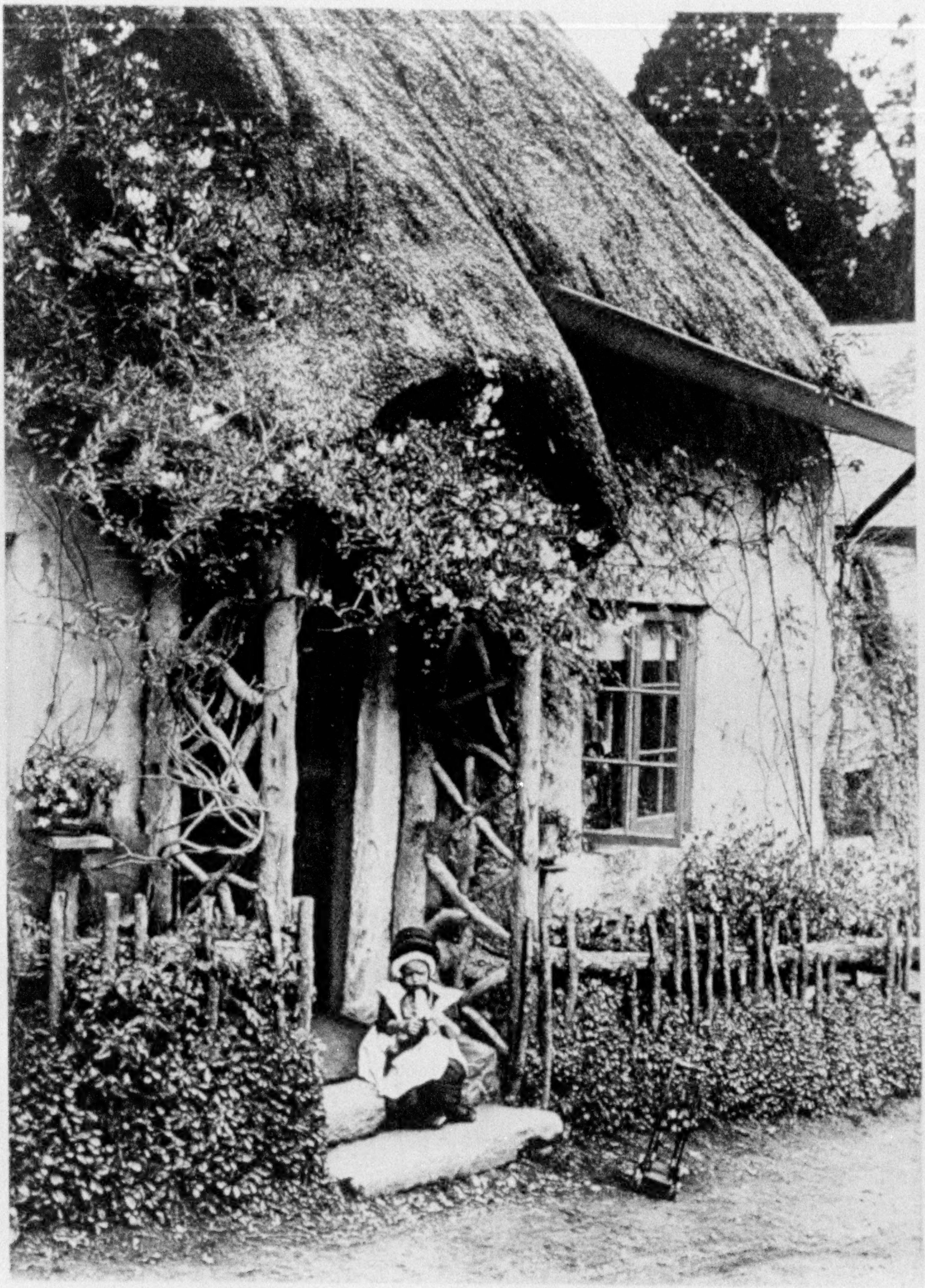

A WAYSIDE SCENE IN RURAL ENGLAND

The entrance to one of the quaint old cottages in the village of Cockington in the south of Devonshire. All the houses in this village have thatched roofs and are very old; many of them have been standing for over three hundred years. Photo by A. W. Cutler.

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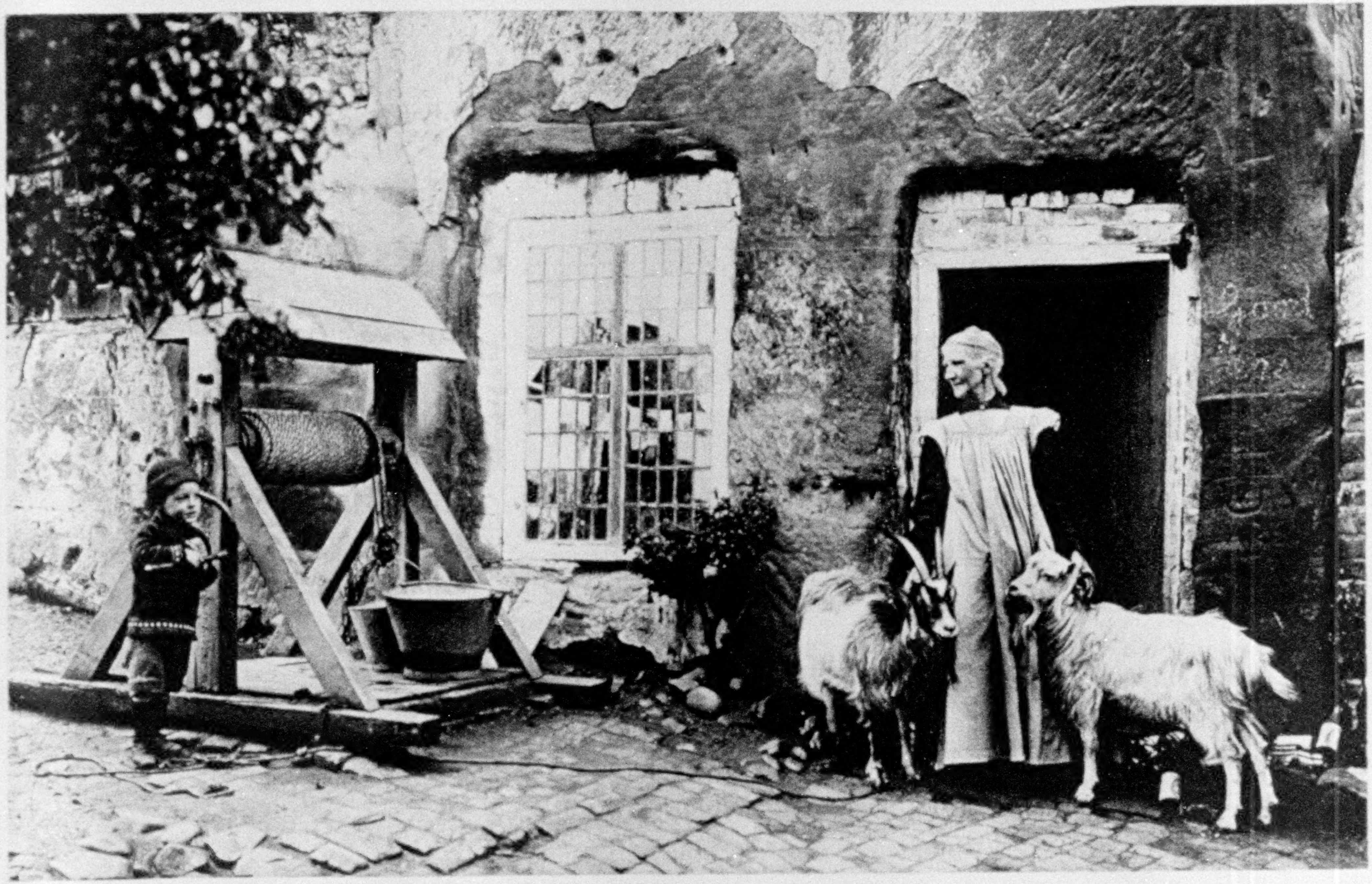

SOME ENGLISH CAVE DWELLERS

This is one of a group of rock dwellings known as Holy Austin Rockery in Worcestershire, England. Recent investigations have proved this to be the oldest inhabited rock dwelling in England, its earliest occupation dating back 900 years. Before the Reformation, the rock was occupied by Augustinian friars whence it derives its present name. This old lady and her little grandson now live in the Rockery which contains several rooms with rough untrimmed walls and ceilings. Photo by A. W. Cutler.

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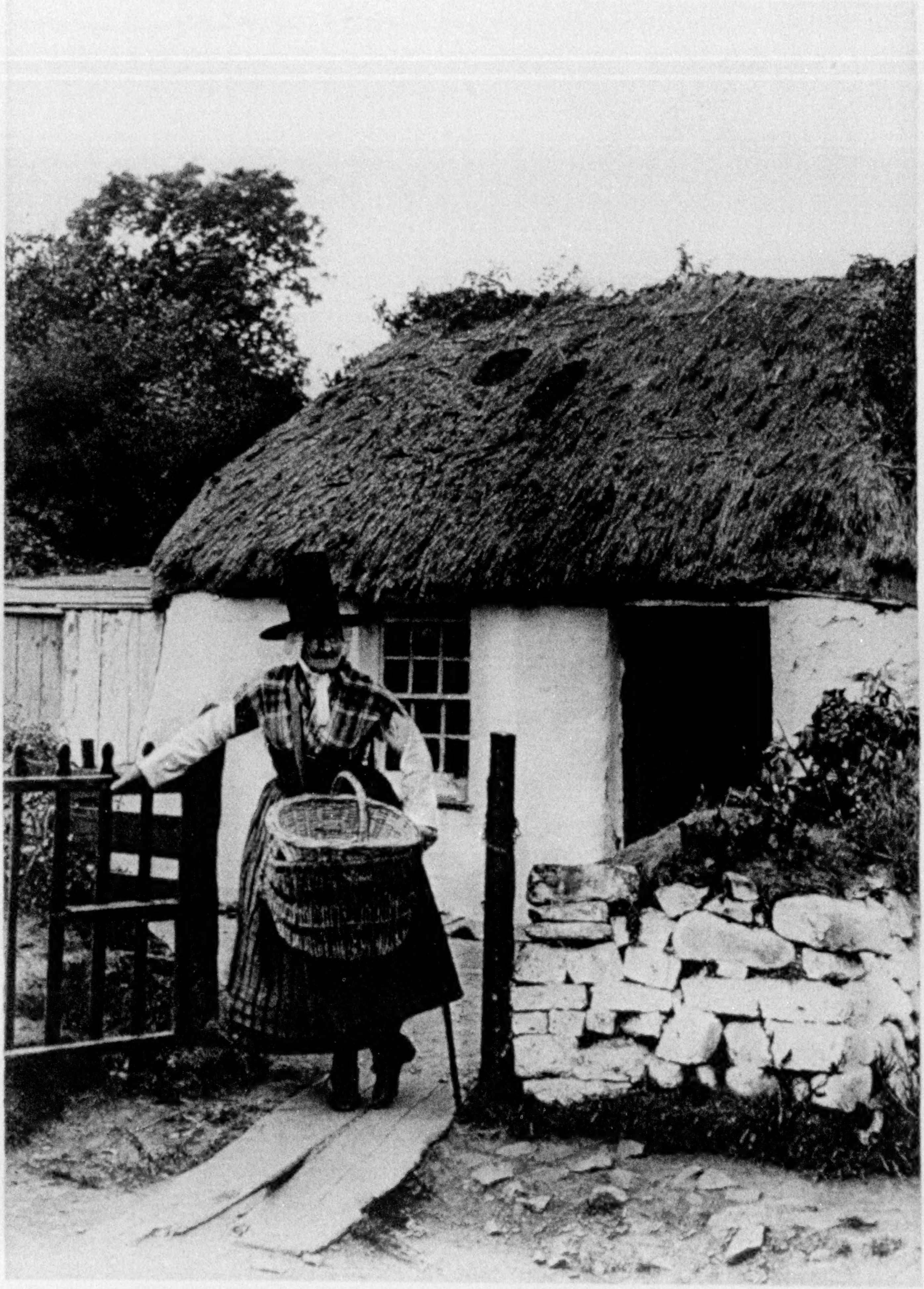
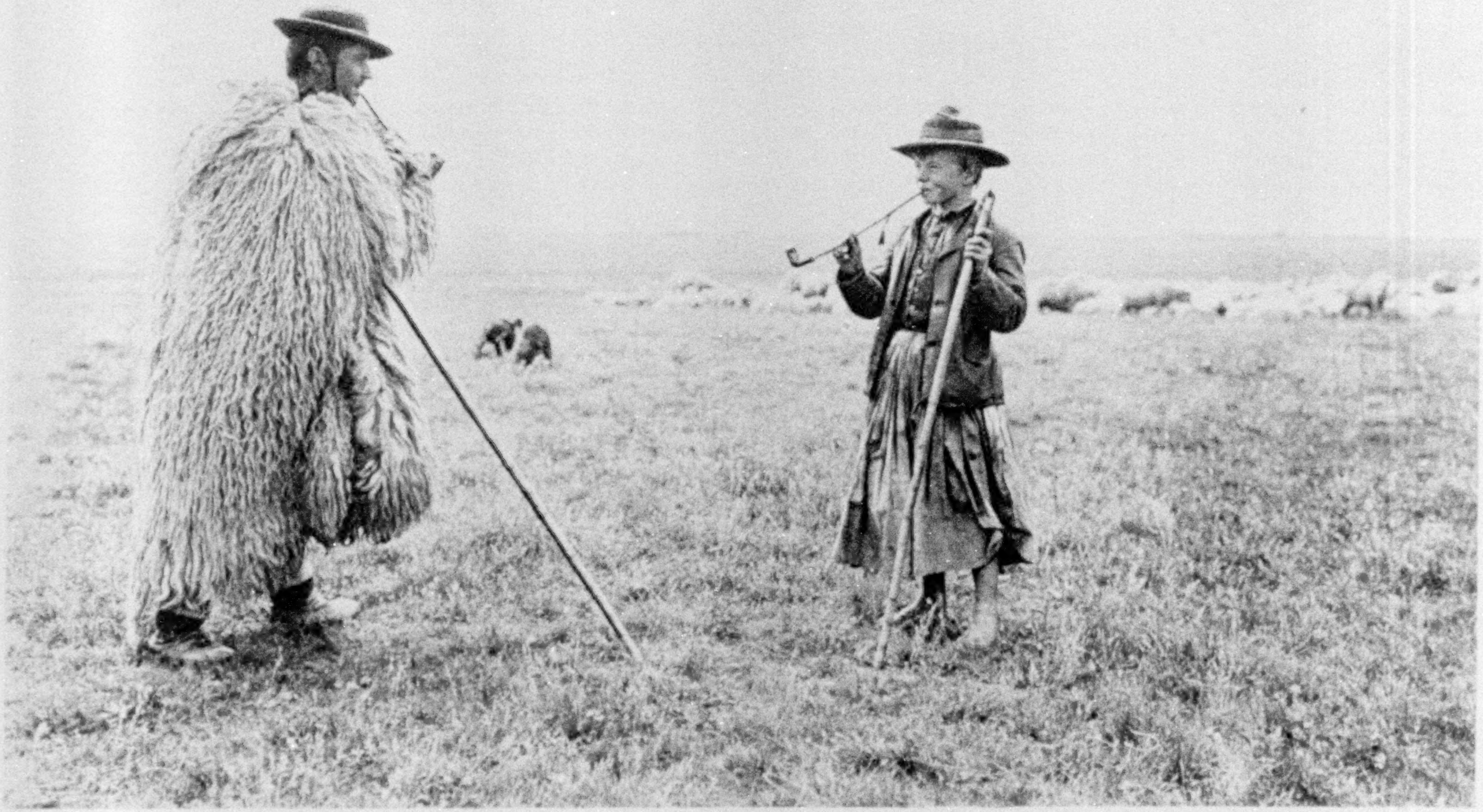


A BIT OF OLD WALES

This old fish-wife is wearing the fast disappearing Welsh costume, the most curious feature of which is the high beaver hat worn over a frilled muslin cap. The top basket is used for cockles and mussels, the lower one for fish. The picture was taken at Llangurn in South Wales. Photo by A. W. Cutler.

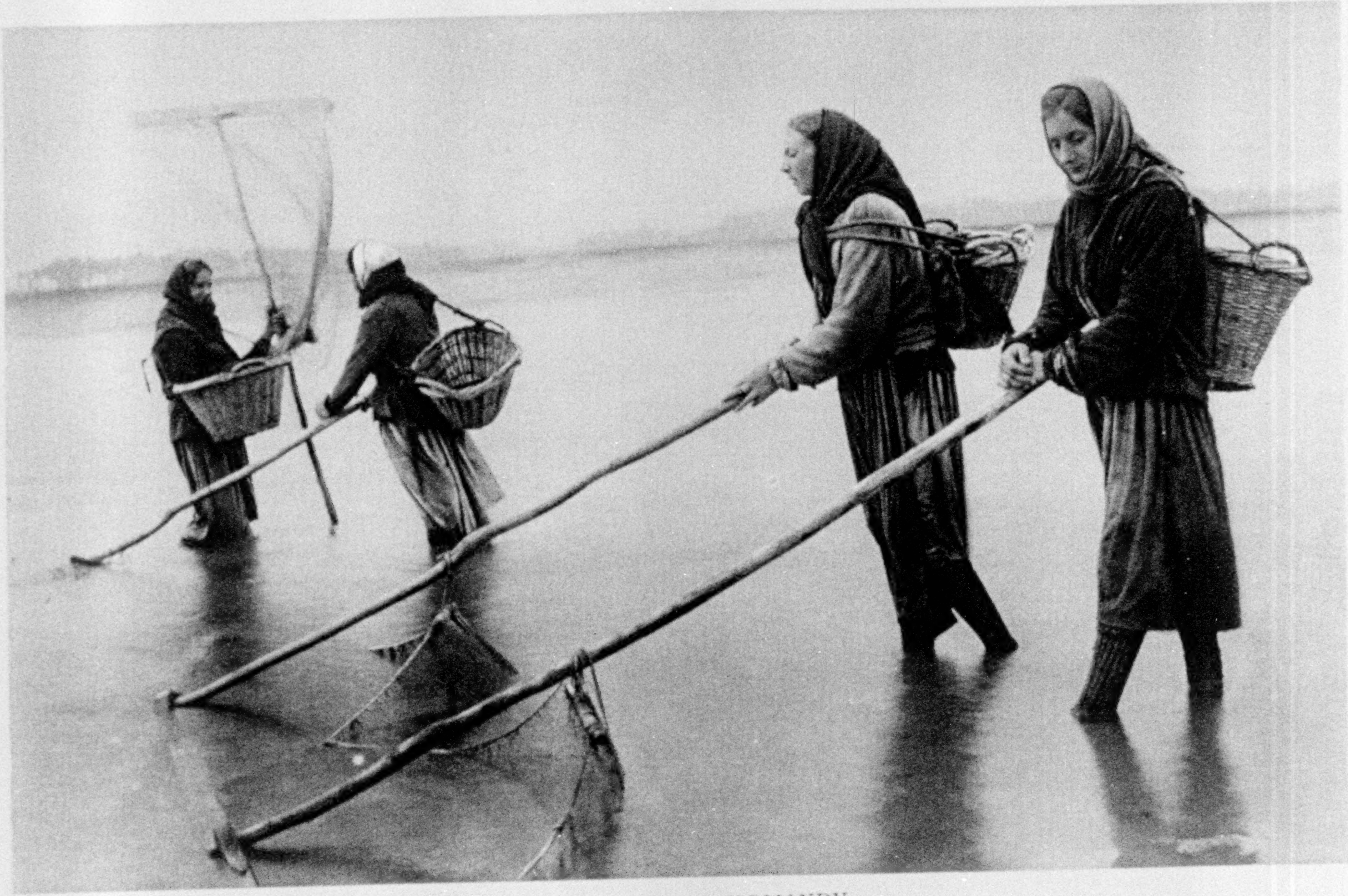
A REST BY THE WAY

A quiet scene in the countryside of Belgium near the French border. The old man is on his way home with his little granddaughter, seated in the cart drawn by dogs. These dog carts are often seen in Belgium and Holland, bakers, milk dealers, and peddlers using dogs to assist in the distribution of their wares.



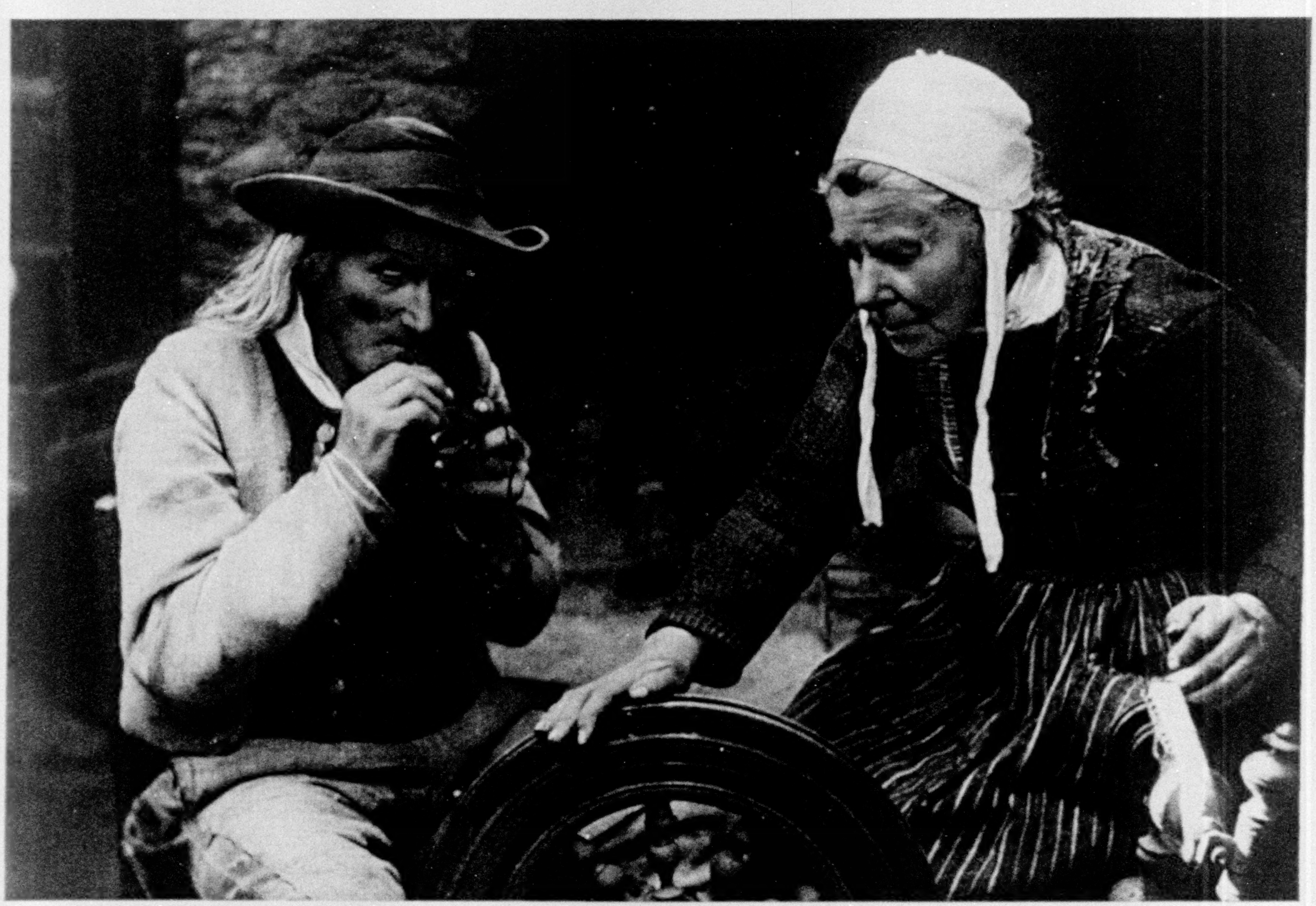
SHEPHERD BOYS OF THE GREAT HUNGARIAN PLAINS

The immense sheepskin coat is typical, so are the long pipes. The younger boy is not wearing skirts but trousers so full and baggy that at first sight they appear to be articles of female attire. Photo by A. W. Cutler.



SHRIMPING IN NORMANDY

Along the Norman coast, where shrimps are abundant on the sandy shores, this is a common sight at low tide. The girls wade through the shallow water pushing their nets before them and transferring the shrimps, as the nets fill, to the baskets on their backs.



AT THE SPINNING-WHEEL

Brittany today remains the most primitive part of France. The peasants cling tenaciously to their ancient costume, the men to their short, velvet-trimmed jacket and the huge broad-brimmed hat with great streamers of ribbon hanging down behind. The women wear white caps, the shape of which is different in each locality.

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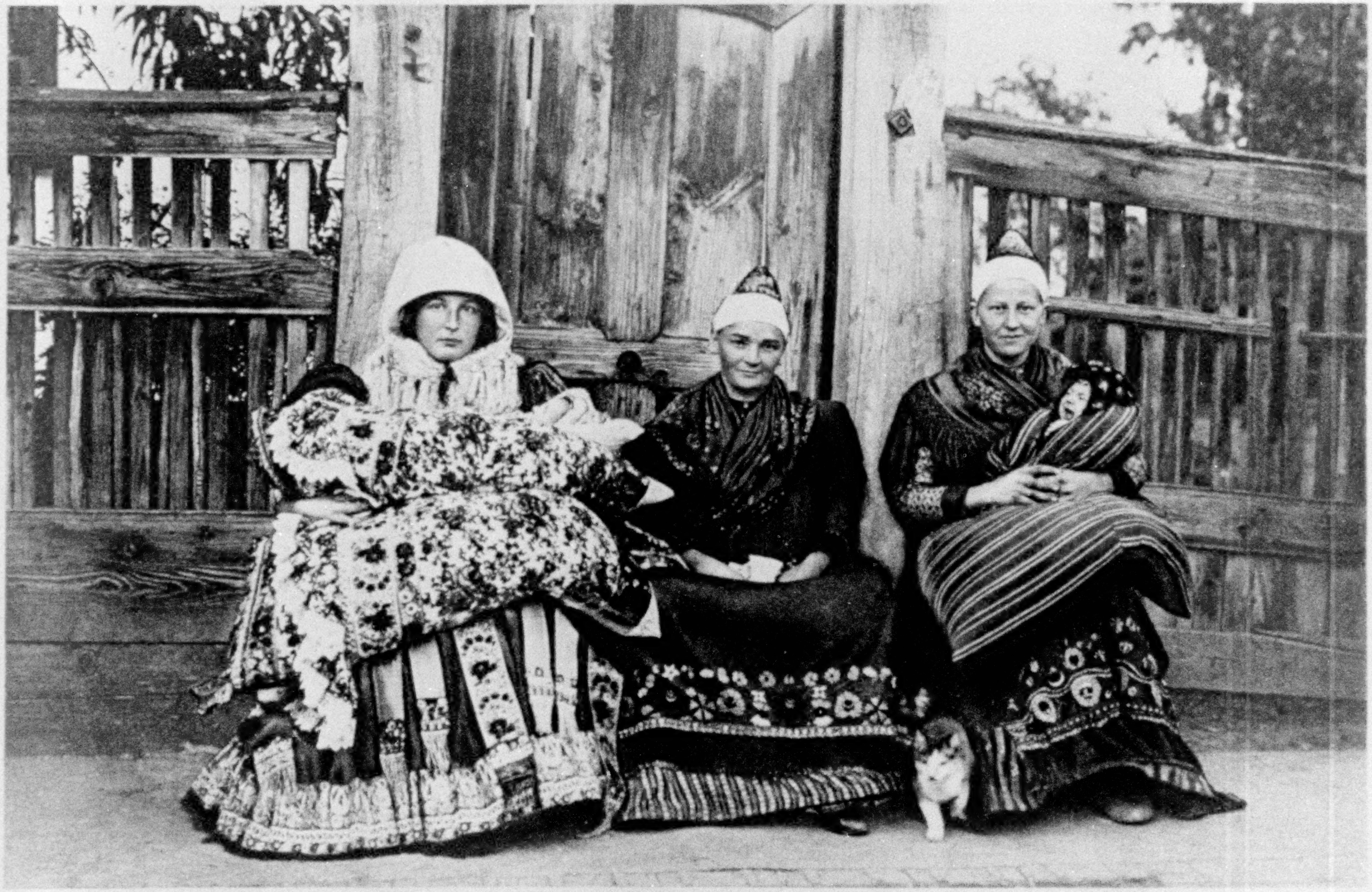
GOOD CHEER FOR THE FISHERMEN

Along the coast of Brittany are found perhaps the most intrepid fishermen in all France, and strangely enough hardly one of them can speak a word of French. They have a Celtic language of their own, not unlike the tongues of their cousins, the Welsh and Irish, on the other side of the English Channel.



HUNGARIAN MOTHERS AND THEIR BABIES

Hungarian peasant women have a curious custom of swaddling their infants on immense pillows. The lady on the left is in her best costume, the skirt of which is embellished with a number of vari-colored ribbons hanging straight down from the waist. The other two women have their hair concealed under cone-shaped baskets, a universal custom in this section. Note the kitten. Photo by A. W. Cutler.

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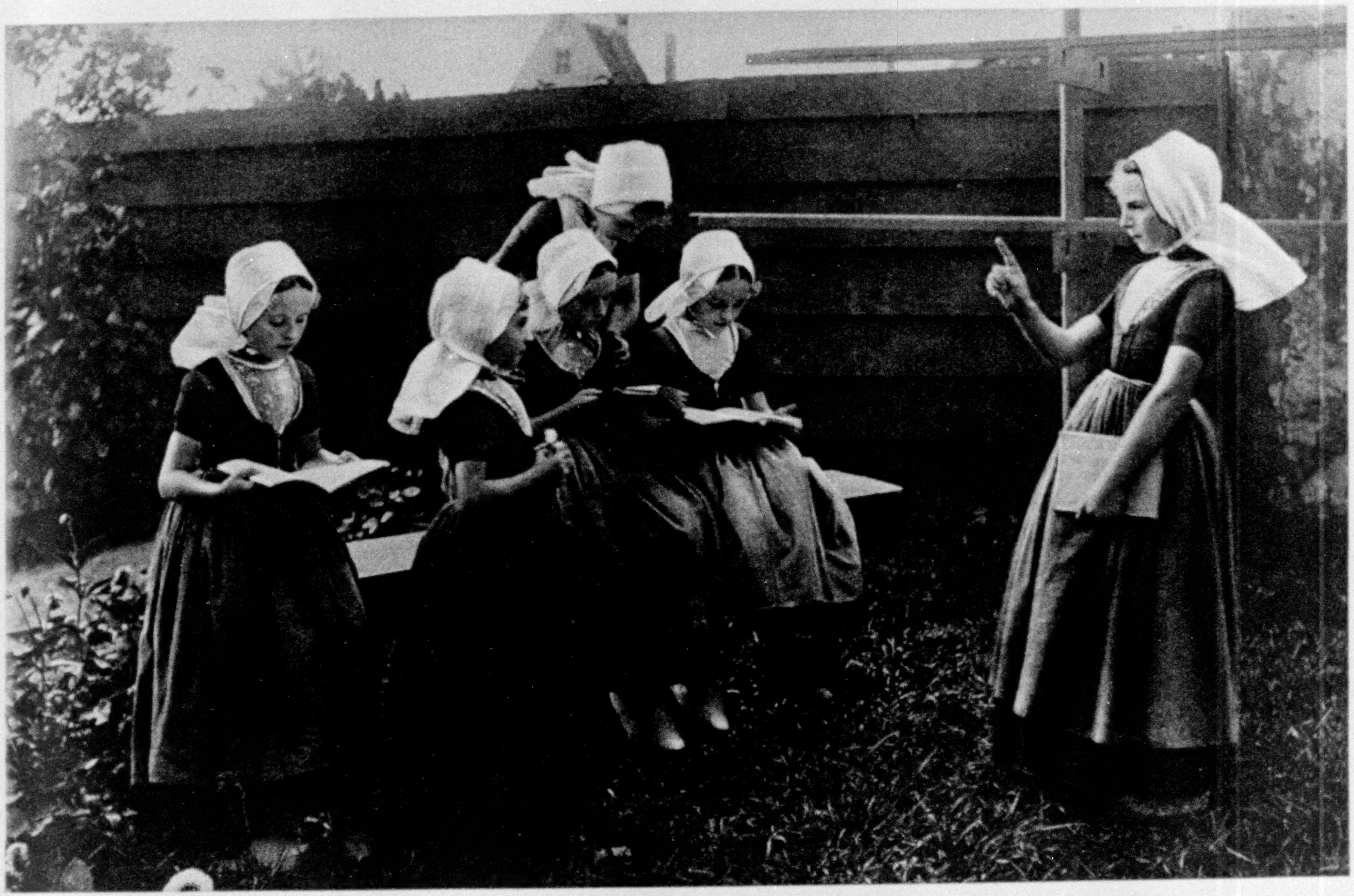
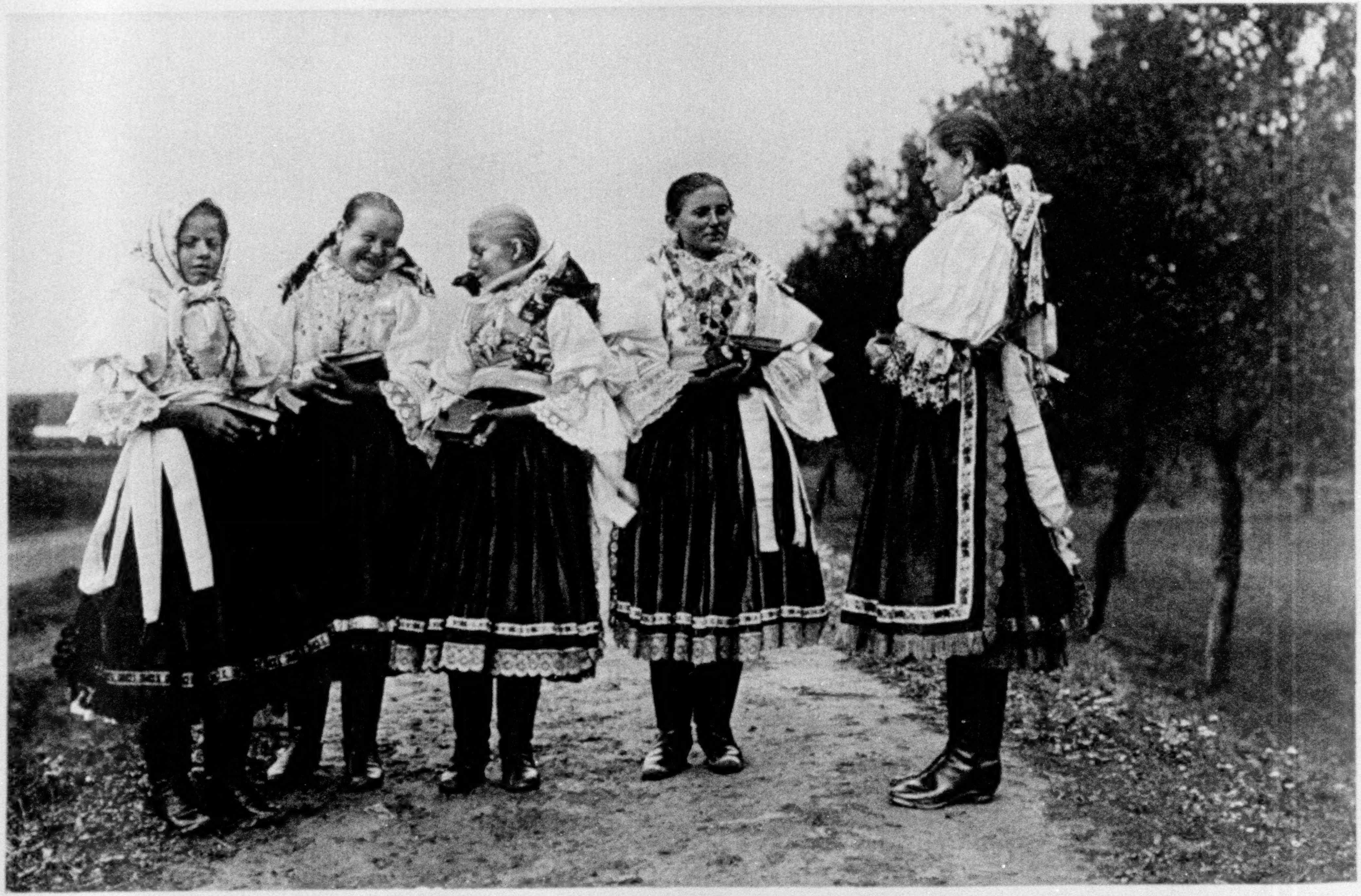


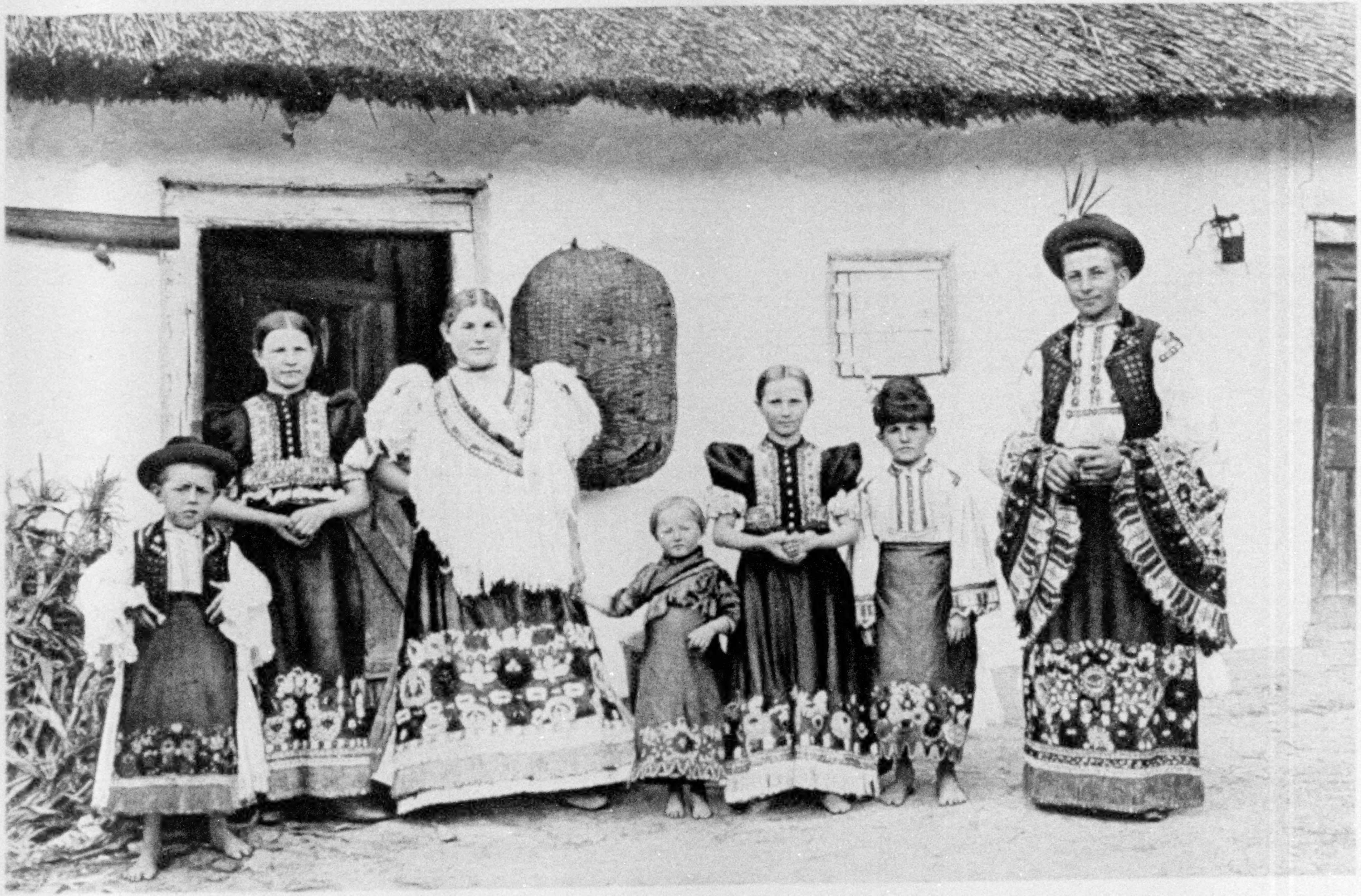
LITTLE DUTCH SCHOOLGIRLS

In the outlying districts of Holland, especially on the islands of the Zuider Zee, many quaint costumes are found. The caps the girls are wearing are held in place by coiled springs of gold set over each temple. These springs are often of ancient workmanship and great artistic merit.



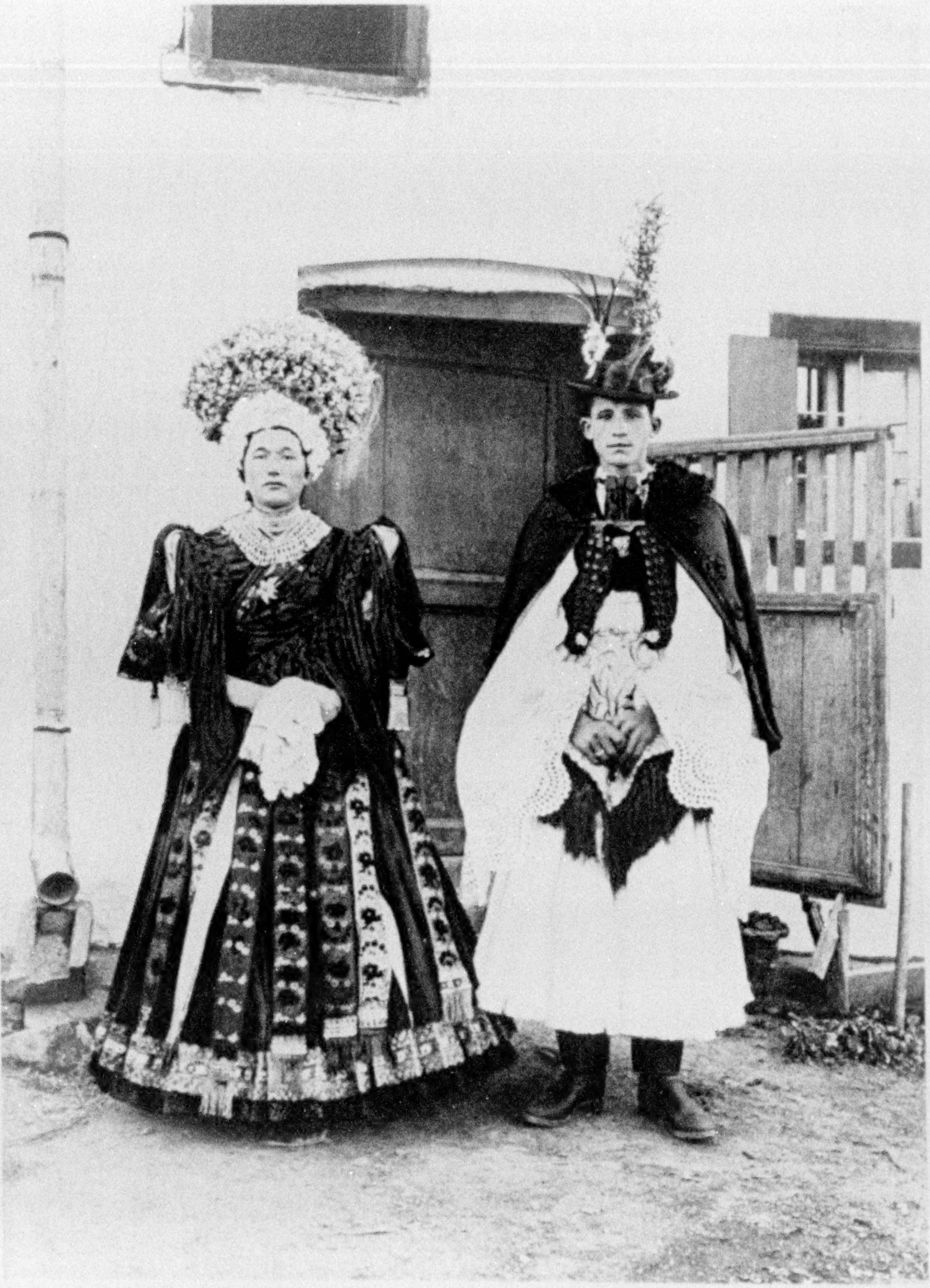
SLOVAK GIRLS IN THEIR BEST, HUNGARY

To see these girls, coming from church on Sunday, in all the glory of their best, it is difficult to realize that throughout the week they work in the fields from early morn to sundown. A curious feature of this much be-ribboned costume is the lack of head-dress. The girls wear no stockings—just a cloth bound round the foot to make the high boot fit snugly. Photo by A. W. Cutler.



A FAMILY GROUP IN HUNGARY

These peasants have a passion for embroidery. Note the long black apron worn by both sexes, with its richly ornamented designs in colored wools—sometimes in silks. The puffed sleeves of the women are very stiff and uncomfortable, in striking contrast to those of the men, which are flowing and beautifully worked. Photo by A. W. Cutler.



THE BRIDE AND BRIDEGROOM, HUNGARY

The enormous ornament on the bride's head is not so heavy as it looks, being composed largely of tinsel. It will be noted that the bridegroom's hat is also gay with flowers and tinsel. Note the ribbons hanging from the bride's belt, as also on page 237. Photo by A. W. Cutler.

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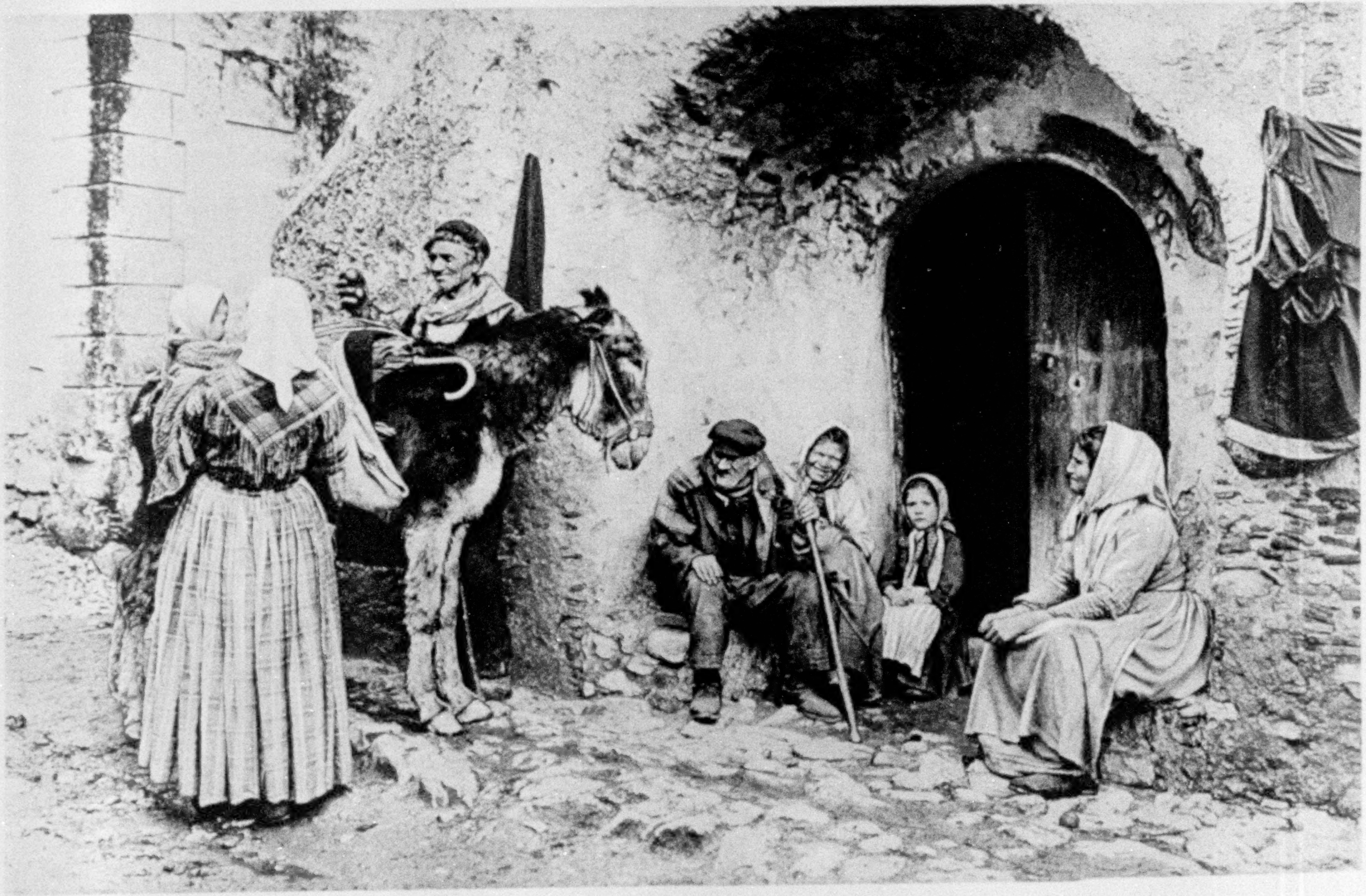
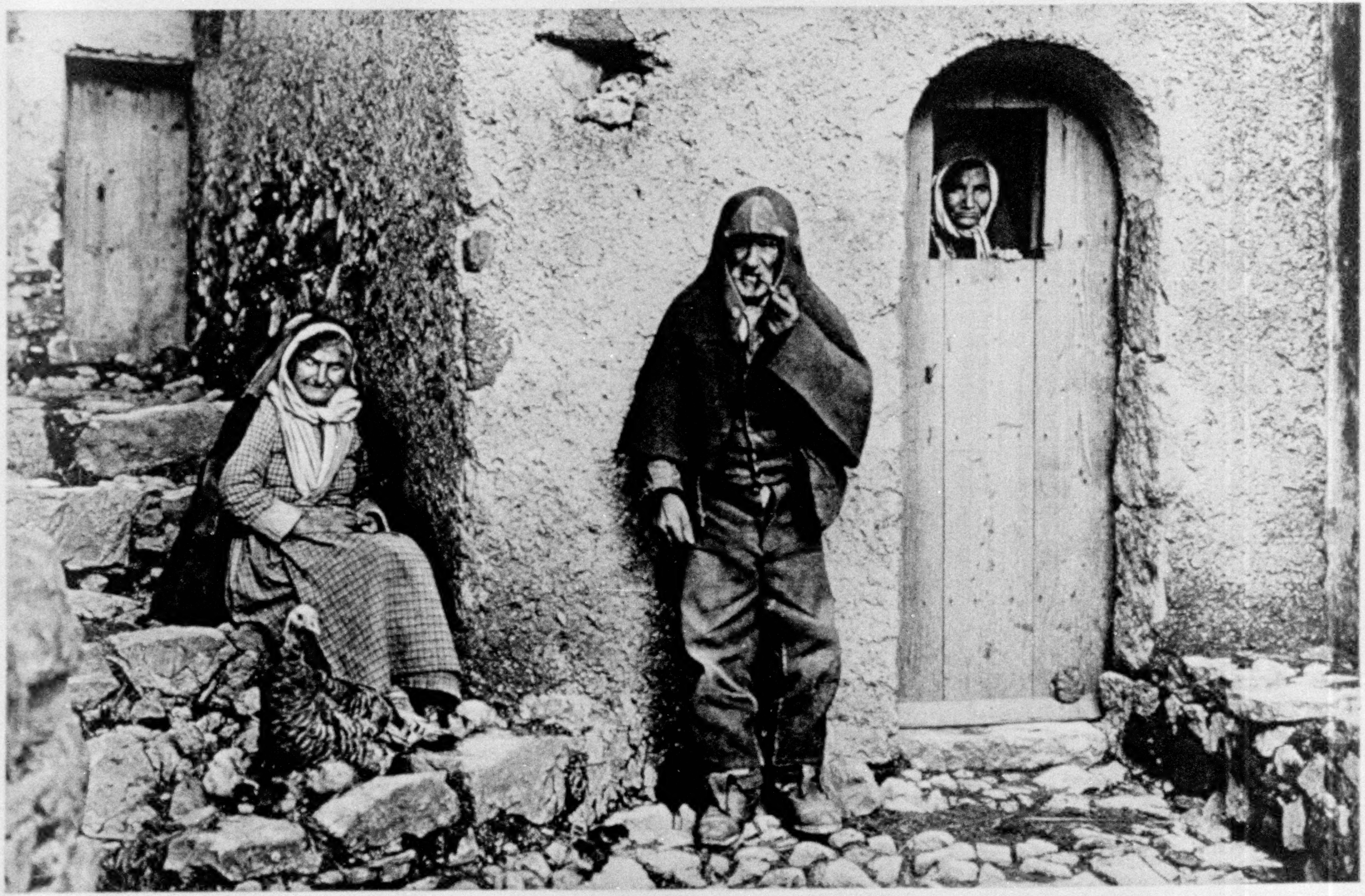


PEASANT LIFE IN SICILY

A typical scene among the peasants of the mountains of Sicily, where this picture was taken in the streets of the little village of Mola. The old man has come in to market on the family donkey and is offering an orange to the grandchild of one of his cronies. Photo by A. W. Cutler.



WITH THE SICILIAN MOUNTAINEERS

The old lady on the left has dropped off into a doze while watching her turkey and chicks. Note the woman looking through the hole in the door. This hole serves both for window and chimney, the fire being kindled in a corner of the room on the stone-flagged floor. Photo by A. W. Cutler.

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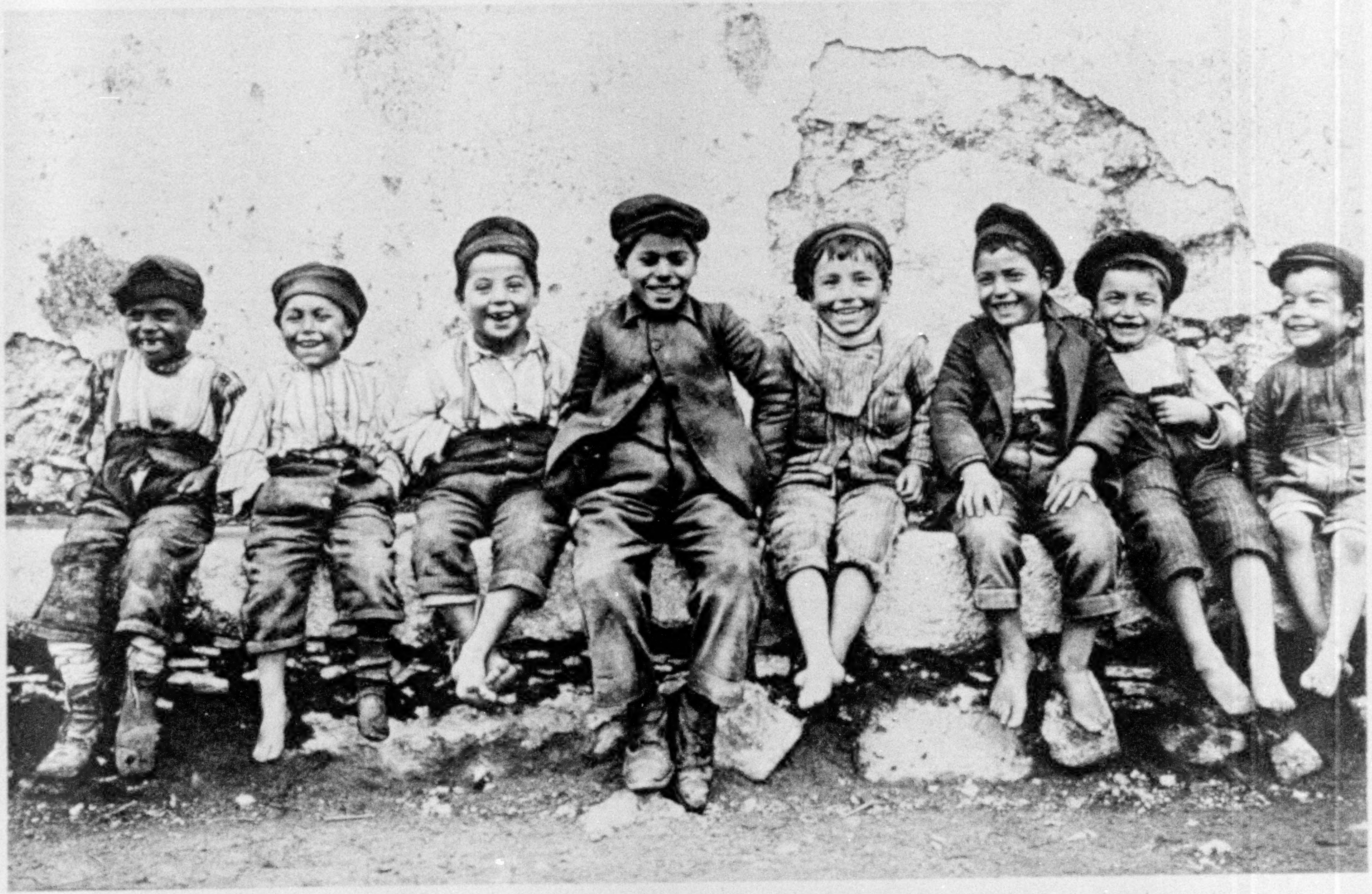

SOME JOLLY SICILIAN BOYS

These youngsters come from a little mountain village just above Taormina in Sicily. Though they are all of them poorer than Job, they are as happy as the birds in May, and if a few pennies are forthcoming there is no repressing their high spirits. Photo by A. W. Cutler

THE PROBABLE EFFECT OF THE PANAMA CANAL ON THE COMMERCIAL GEOGRAPHY OF THE WORLD

By O. P. Austin

WHAT will be the effect of the Panama Canal upon the commercial and travel geography of the world? Will it change travel routes, stimulate commerce, and bring the people of great land-masses into closer relationship?

The Suez Canal, opened in 1869, shortened the travel distance between western Europe and eastern Asia by 3,400 miles, and in doing so opened new highways of travel and traffic, multiplied interchanges of merchandise, and developed closer relations between the Occident and the Orient. The Panama Canal will shorten travel routes between New York and Yokohama by 3,750 miles; between New York and Shanghai, about 2,000 miles; between New York and Australia, about 3,000 miles, and between New York and western South America by from 3,500 to 7,000 miles. It will also reduce the distance from Europe to western South America by 3,000 miles and to western North America by more than 5,000 miles.

Will it also divert travel and traffic from the present established routes, stimulate commerce, and develop closer relations between the people of the countries thus brought closer together?

International commerce doubled in the 30 years following the opening of the Suez Canal, and business and personal inter-relationship between the Occident and the Orient was increased in like proportion. Will similar results follow the like shortening of trade and travel routes by the Panama Canal?

WHAT DETERMINES STEAMSHIP ROUTES

Highways of travel on the ocean are influenced by surrounding conditions just as are those on land. The shortest distance between two given points is not always the best on the ocean any more than is the case on a continent or island. True, the ocean surface gives a level "road-bed" for a direct line of travel, while a route over a land surface must make frequent detours to obtain even approximate levels for moving great quantities of merchandise.

But there are other important conditions which affect the ocean route. Plentiful freight supplies, present and prospective, interchangeability of the products of the countries forming the termini of the routes, "way stations" on such routes, plentiful coaling stations, and cheap coal of a quality suitable for steamship engines, and even favorable winds and ocean currents are among the factors contributing to the success of routes of travel upon the ocean.

Argentina, for example, has ample supplies of freight, but steamship lines do not develop rapidly between that country and the United States because most of the Argentine products are similar to our own, and there is no reason why she should send her wheat and corn and pork to this country, which has a surplus of those articles. Cuba, the world's greatest producer of cane sugar, sends little if any of it to Europe, because that part of the world produces from beets all the sugar it requires. England, the world's greatest coal exporter, sends no coal to the United States, which has unlimited supplies of her own. So, shortening of distances between great sections will not develop steamship business unless the products of the two sections are of such character as to justify exchanges.

In some instances, however, steamship routes adjust themselves to locally adverse conditions. The steamer which carries wheat and corn and meat from Argentina to Europe may bring the silks and woolens and laces of Europe to the United States and then return to Argentina loaded with agricultural implements, iron and steel manufactures, and mineral

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oil from the factories and refineries of this country.

THE IMPORTANCE OF COALING STATIONS

Coaling stations and coal supplies are an important factor in determining routes of travel for steamers. The stations are numbered by hundreds and scattered over the entire travel world, yet the quality and prices of the material which they offer and the distances between ample and cheap supplies have much to do in determining steamship routes.

British coal is the standard for steamships in Europe, the Mediterranean, and western Asia; India, Australia, and Japan are the chief sources of supply for eastern Asia and the western Pacific, and the United States chief purveyor to all of America and adjacent waters. Australian, Japanese, and American coals are somewhat cheaper than the English, and if the stations tributary to the Panama routes were so near to each other that the steamship could get supplies at frequent intervals, and thus devote most of its carrying space to merchandise rather than to large coal supplies, the routes via the Panama Canal would offer special attractions.

Coal is nearly one-half the cost of running a freight vessel. A large share of the freight now moved on the ocean is carried in "tramp" steamers of from 3,000 to 5,000 "net register" tons capacity, but an actual carrying power of about twice as many tons of dead weight.

To charter a vessel of, say, 3,000 register tons, including the officers and crew, costs about $200 a day, while the coal required to run such a vessel at the very moderate speed of 10 miles an hour would cost about $150 per day. For passenger steamers, making higher speed, the cost of coal is much greater, and would probably be quite as much as the hire of the vessel and all of her officers, crew, subsistence, and incidental expenses.

A freight vessel of the type above described, carrying about 5,000 tons dead weight and making about 10 miles per hour, would probably burn about 3,000 to 4,000 tons of coal on a trip from New York to Yokohama or Shanghai and return, and if a saving of $1.50 per ton could be made by going via Panama and using the cheaper coal offered by that route, the economy in coal alone might turn the scale in favor of that route.

So it is apparent that coaling stations, coal supplies, and coal prices are factors of considerable importance in determining the choice of routes where distances are nearly equal.

THE SPHERE OF INFLUENCE OF THE PANAMA CANAL

The sections of the world which may be considered as probably within the "sphere of influence" of the Panama Canal are the eastern and western coasts of America, the eastern coast of Asia, and the islands of the Pacific. All of western America will be nearer to Europe than at present, and all of western America and most of eastern Asia and Oceania will be nearer to the eastern coast of America than at present.

A study of the production and consumption of the various countries lying within the canal's sphere of influence shows that their various products are thoroughly interchangeable. The western coast of South America offers chiefly natural products. Chile has nitrates, copper, and comparatively small quantities of wheat and other grains. The nitrates are needed by both the United States and Europe; the copper comes to the United States to be smelted and refined and the grains are wanted by Europe. In exchange for these Chile takes manufactures, and both the United States and Europe have manufactures for sale in ever-increasing quantities.

The Philippines and the Dutch East Indies offer sugar, tobacco, hemp, and other tropical products, and both Europe and the United States want these and pay for them chiefly in manufactures, which form the bulk of the imports of these countries. Australia and New Zealand offer meats, wool, and hides and take manufactures in exchange; and both the United States and Europe want the wool and hides, and Europe wants also the wheat and meats, and she, as well as the United States, wants to pay for them in manufactures.

It will be seen, therefore, that the products of the various sections within the canal's "sphere of influence" are of a thoroughly interchangeable character.

DOES THE CANAL REALLY SHORTEN TRADE ROUTES?

Next we must consider the relative distances via the Panama Canal and other existing routes, measured between great trading centers. From Europe we may take Liverpool as a representative point. It represents, with a fair degree of accuracy, the initial point for the trade of Europe.

For the western coast of America we may consider the chief ports from Chile to Washington. For the Far East we may consider Yokohama, Shanghai, Hongkong, Manila, Sydney and Melbourne, Australia, and Wellington, New Zealand, as more or less within the "sphere of influence" of the Panama Canal, while Singapore, Colombo, and the ports of India are so much nearer to both Europe and the United States via the Suez that they need not be considered in a comparison of distances via the two routes.

Distances via Panama to Western Ports of America from Liverpool, New York, and New Orleans Respectively (in nautical miles)

Via Panama to—	From Liverpool.	From New York.	From New Orleans.	Advantage over Liverpool.	
				New York.	New Orleans.
Valparaiso	7,207	4,633	4,054	2,574	3,153
Iquique	6,578	4,004	3,425	2,574	3,153
Callao	5,937	3,363	2,784	2,574	3,153
Guayaquil	5,384	2,810	2,231	2,574	3,153
Acapulco	6,017	3,443	2,864	2,574	3,153
Honolulu	9,276	6,702	6,123	2,574	3,153
San Francisco	7,836	5,262	4,683	2,574	3,153
Portland	8,486	5,912	5,333	2,574	3,153
Port Townsend	8,606	6,032	5,453	2,574	3,153

Distances from New York, New Orleans, and Liverpool Respectively to Principal Ports of Eastern Asia and Oceania (in nautical miles)

To—	New York via Panama.	New Orleans via Panama.	Liverpool by shortest route.*
Yokohama	9,798	9,219	11,678
Shanghai	10,649	10,070	10,607
Hongkong	11,691	11,112	9,785
Manila	11,548	10,966	9,701
Melbourne	10,028	9,427	11,654
Sydney	9,811	9,232	12,235
Wellington	8,540	7,939	11,975

* Via Suez, except to Wellington via Magellan Strait.

THE ADVANTAGES OF THE PANAMA ROUTE

It will be seen from the above tables (1) that both New York and New Orleans will be so much nearer to all of western America than is Liverpool that we may expect that an increasing share of the trade of that section will fall to the lot of eastern North America, and (2) that the eastern ports of the United States will be considerably nearer to Yokohama, Melbourne, Sydney, and Wellington than is Liverpool by her shortest route, but (3) that Liverpool will be still nearer Hongkong and Manila than either New York or New Orleans via Panama.

It may therefore be expected that while the canal will give us decided advantages in the trade with western America and increase the share which we have of that trade, we are not justified in expecting marked changes in the share which we shall get of any part of the Orient except that with Japan and Australia and New Zealand.

However, the Panama route so much shortens the distance to the western coast of America, both from eastern America and western Europe, that we may expect to see most of the trade with western America go via Panama, except perhaps in case of European commerce with the southern ports on the west coast of South America.

EFFECT OF THE CANAL ON OUR DOMESTIC TRADE

One of the most important results of the opening of the canal will doubtless be found in its effect upon the movements of merchandise between the eastern and western sections of the United States. This trade is already very large.

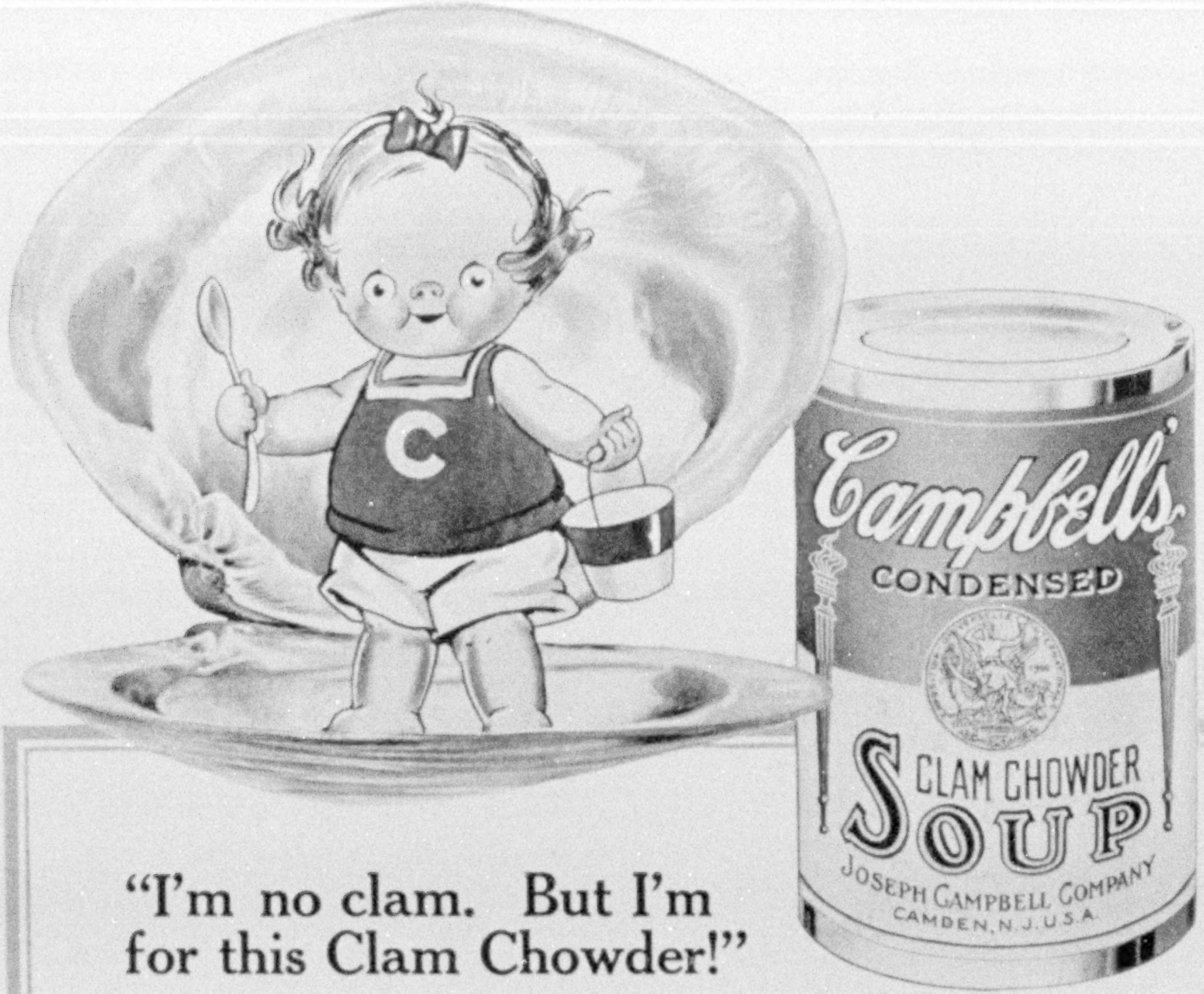
While exact figures are not available, the data at hand seem to justify an estimate of about 3 million tons per annum of freight moved by rail and about a half million tons by water from the Atlantic Coast section to the Pacific Coast section, and about an equal amount from the Pacific Coast section and Hawaii to the Atlantic Coast section. The sums paid as freight charges on these 7 million tons moved between the Atlantic and Pacific Coast sections are estimated at from 250 to 300 million dollars per annum.

Only about one-fourth of the tonnage which now moves westward across the Rocky Mountains originates east of Buffalo and Pittsburgh, while most of the remaining three-fourths originates in the Mississippi Valley, which is the great producing section of the country and rapidly increasing its production of manufactures, which are the most important factor in the west-bound traffic. Of the east-bound traffic across the Rockies, a large share originates near the Pacific coast, especially the fruits, vegetables, fish, wine, barley, and lumber; but only a part of this reaches the Atlantic coast, a considerable share being consigned to the communities of the Mississippi Valley.

At present the railway rates between the Mississippi Valley and the Pacific coast are but little if any less than for the entire distance across the continent, but this will probably be somewhat modified when the steamship rates via Panama become sufficiently low to attract the Mississippi Valley trade toward the Atlantic and Gulf ports. In the actual cost of transportation between the eastern and western sections it may be expected that there will be a marked reduction in the tonnage rates charged.

The water rates between New York and San Francisco, even with the present handicap of transferring to the Panama or Tehuantepec railways and retransferring to steamer, are from 20 to 60 per cent of those charged by the railways, and about one-third of this present water rate is paid for the transferring across the Isthmus.

To sum up, it seems probable that the Panama Canal will carry most of the freight passing between the eastern coast of the United States and the western coast of Latin-America, and that the shorter distances and lower rates which it offers will greatly increase that trade; that the trade between the eastern and western sections of the United States will be greatly increased and transported at a much lower charge per ton; that it will sufficiently shorten the distances to Japan, northern China, Australia, and New Zealand to increase steamship service and materially increase the traffic with those countries, and that the European countries will use the canal in most of their traffic with western America and in exceptional instances with northern Asia, Australia, and New Zealand.



"I'm no clam. But I'm for this Clam Chowder!"

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"The delicious broth makes me think I'm down at the shore again in July with the sea breeze blowing over the beach.

"And the tender clams that are cut up in the broth, the bits of salt pork and the cubed potatoes and the tomatoes and all—O my! It makes me hungry just to think of it. Campbell's is a real clam chowder!"

You'll say so, too. Try it for dinner today.

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Clam Bouillon
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Look for the red-and-white label

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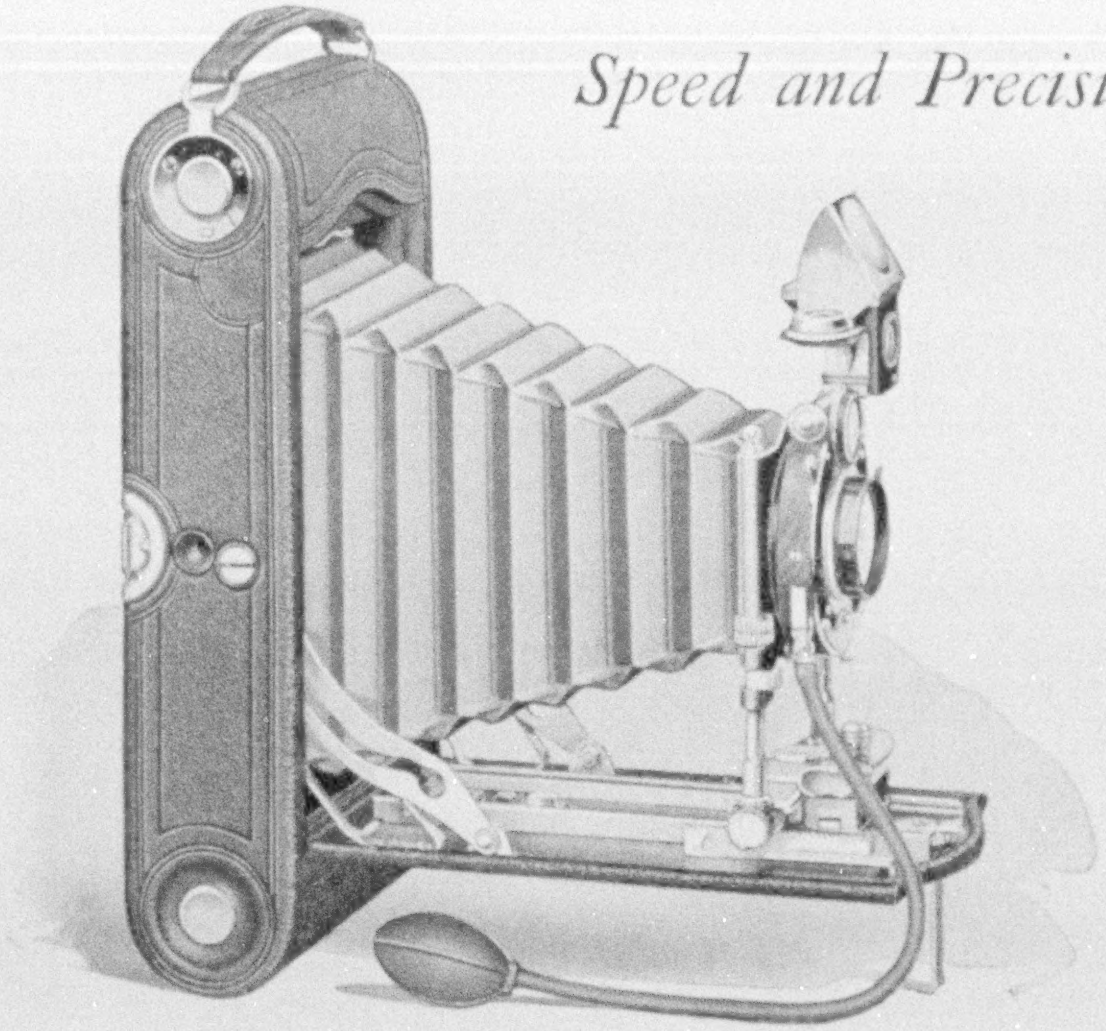

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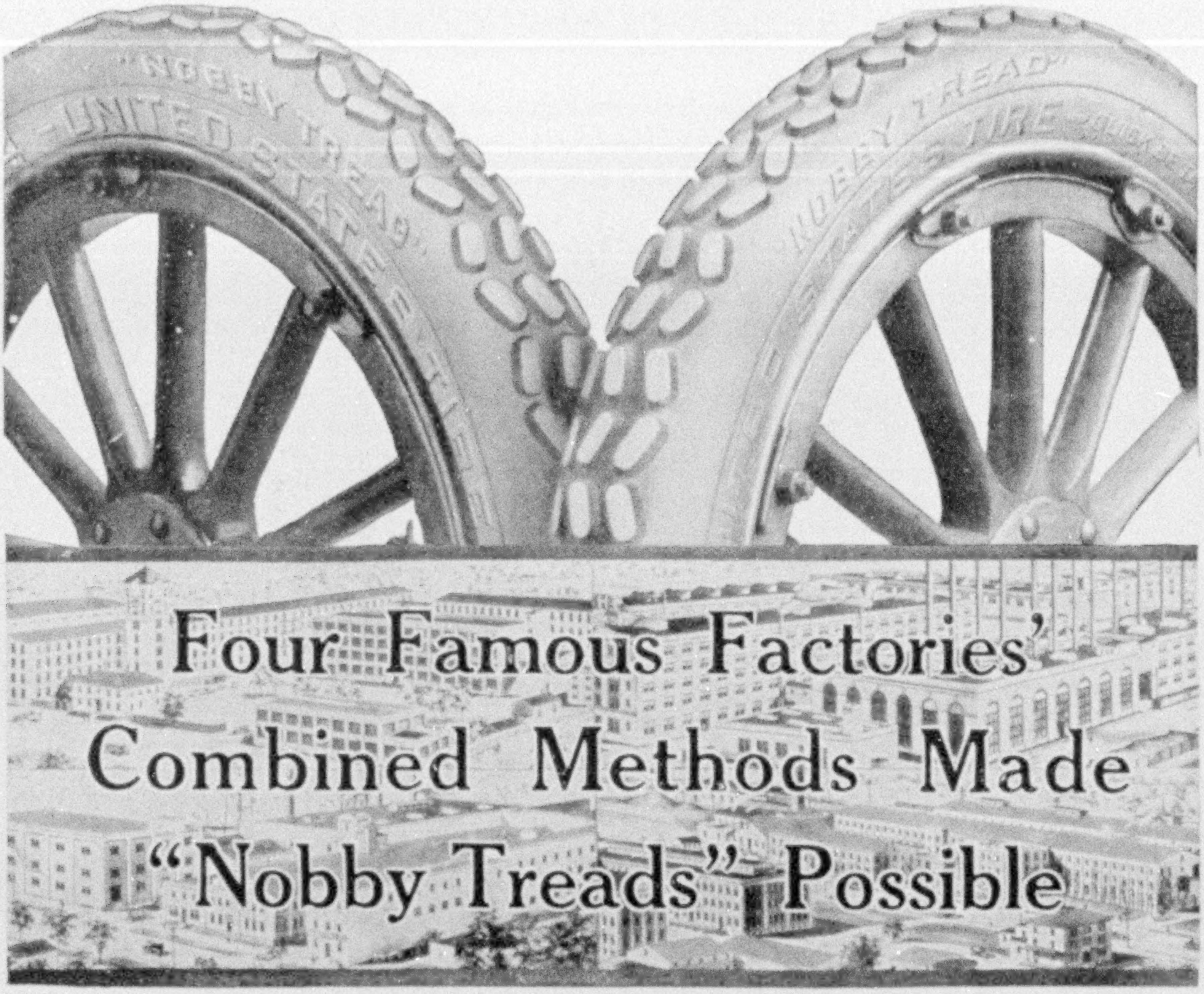

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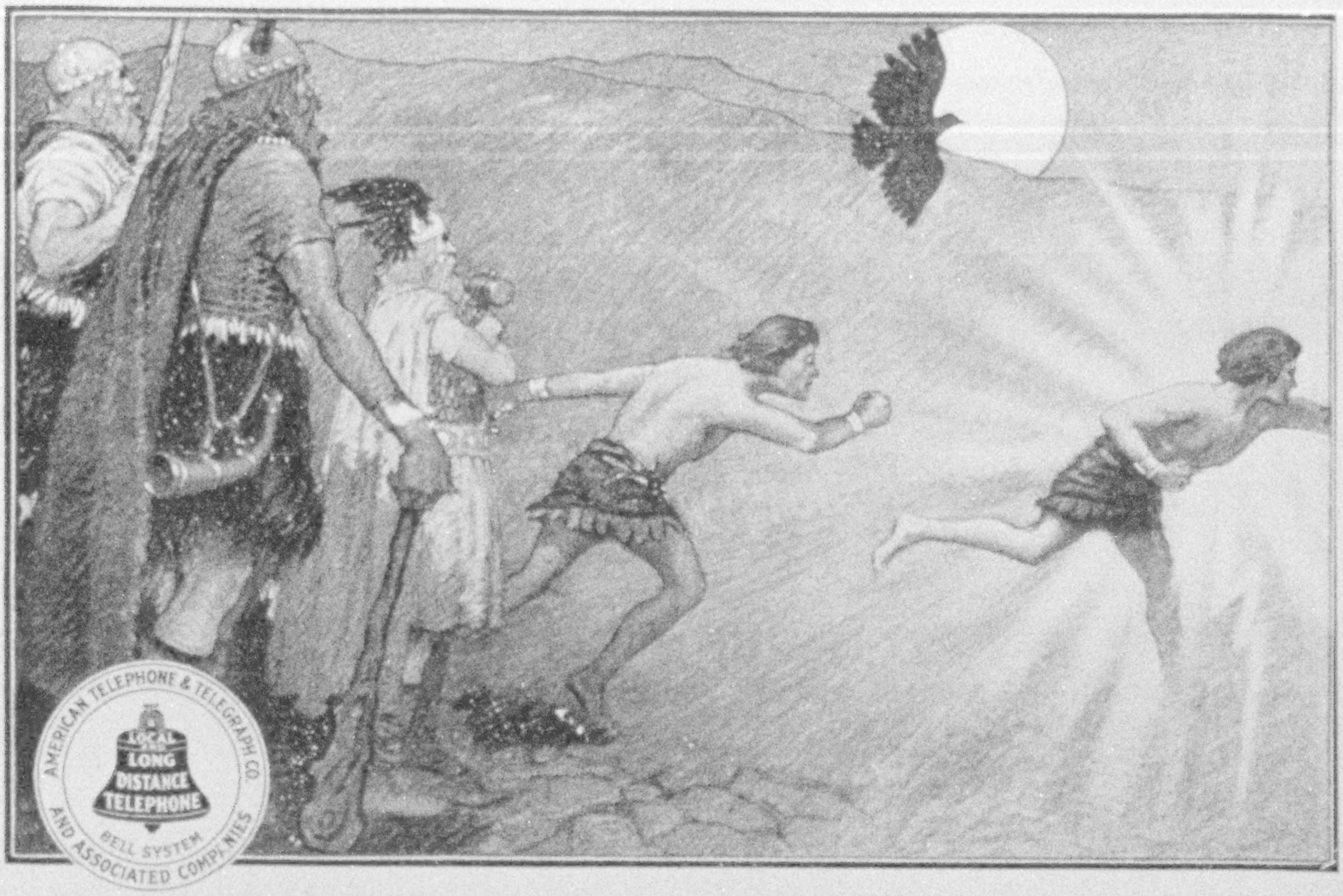

The Magic Flight of Thought

AGES ago, Thor, the champion of the Scandinavian gods, invaded Jotunheim, the land of the giants, and was challenged to feats of skill by Loki, the king.

Thor matched Thialfi, the swiftest of mortals, against Hugi in a footrace. Thrice they swept over the course, but each time Thialfi was hopelessly defeated by Loki's runner.

Loki confessed to Thor afterward that he had deceived the god by enchantments, saying, "Hugi was my thought, and what speed can ever equal his?"

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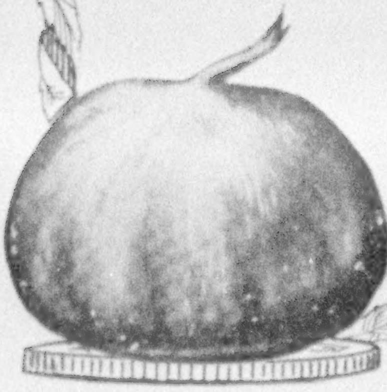

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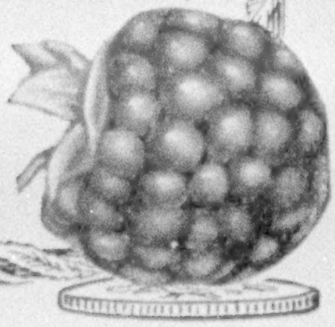

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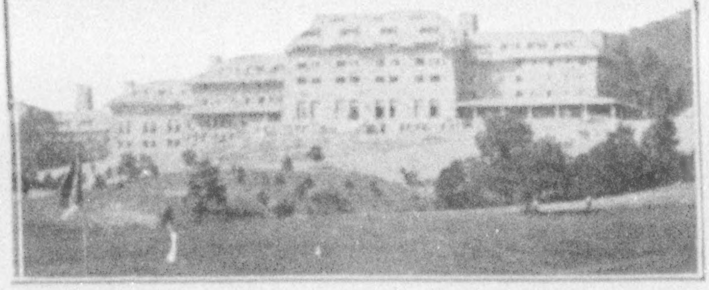

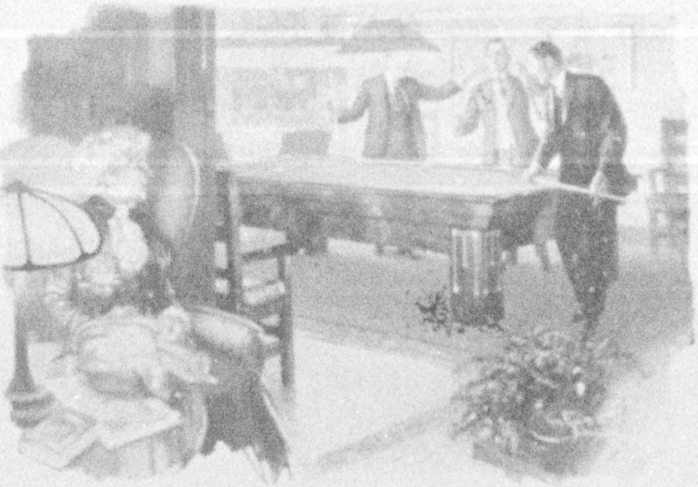

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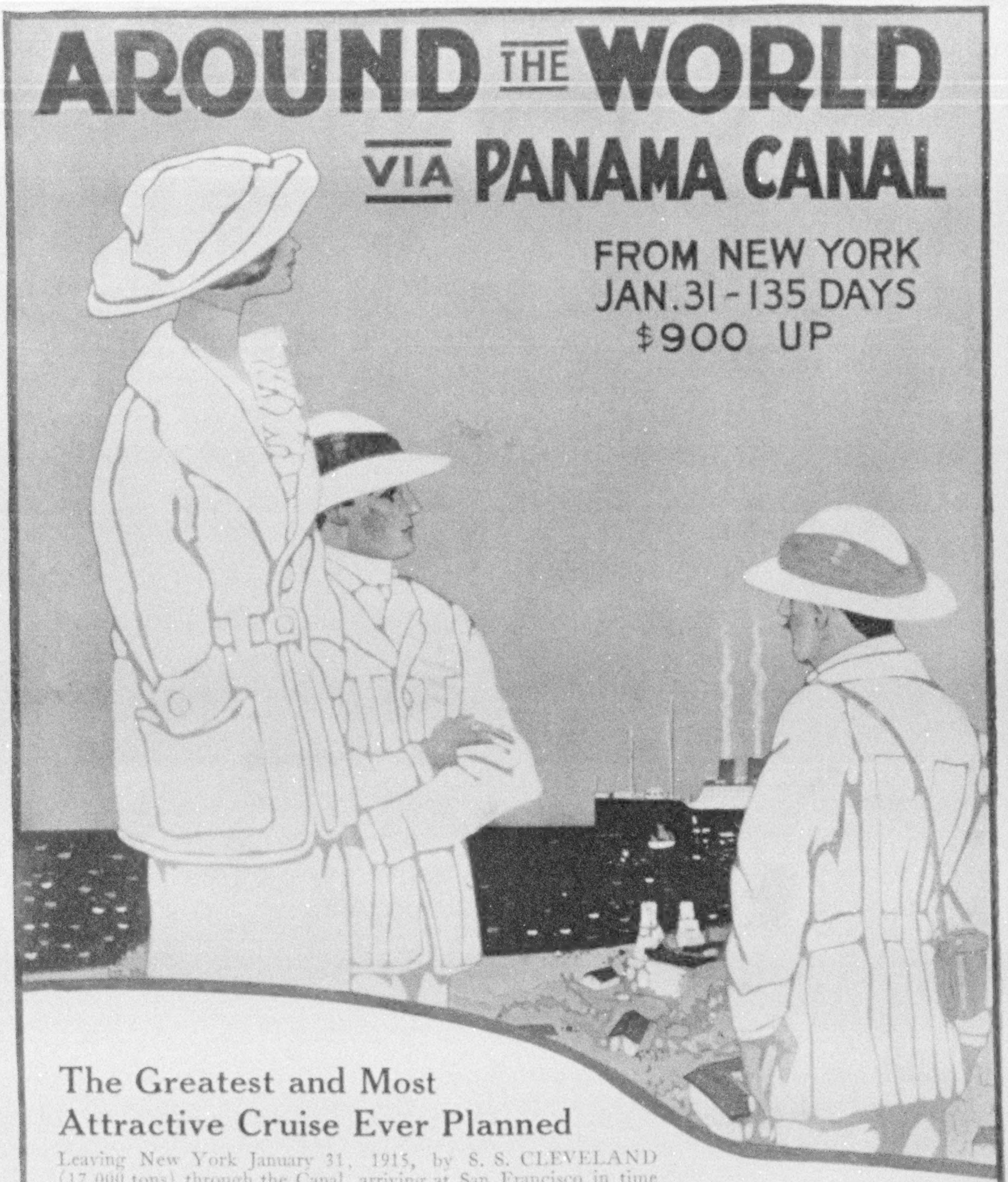

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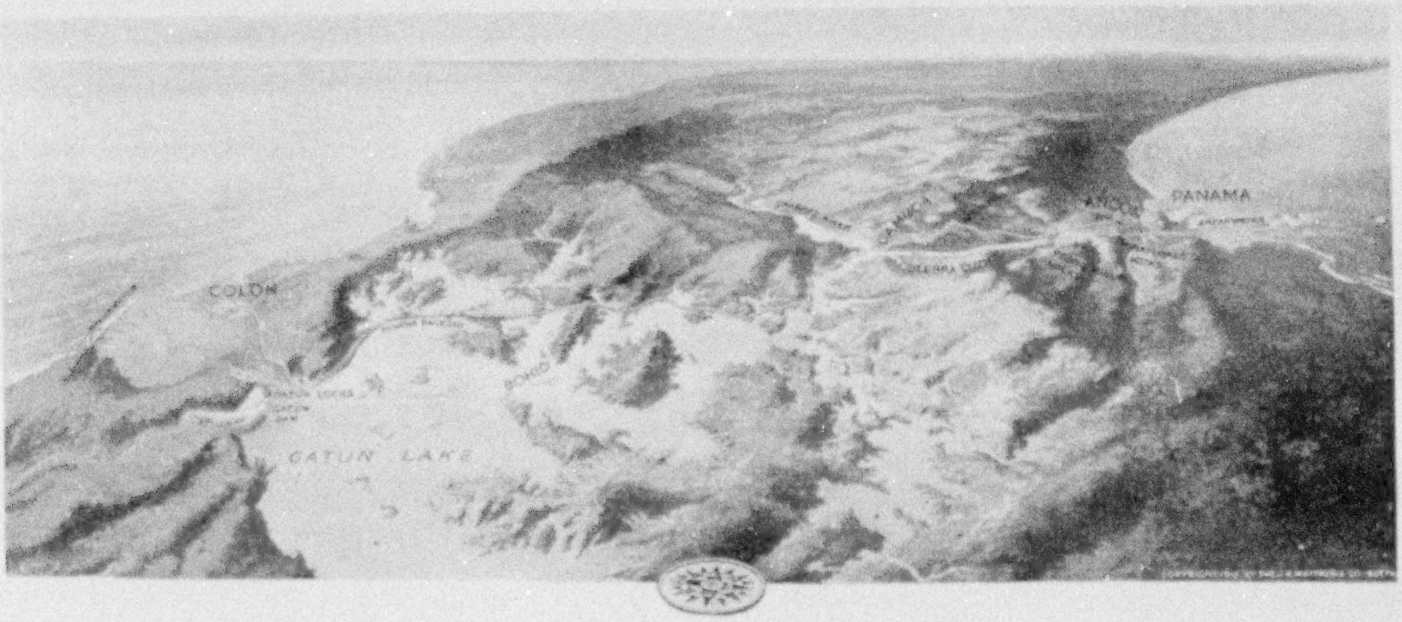

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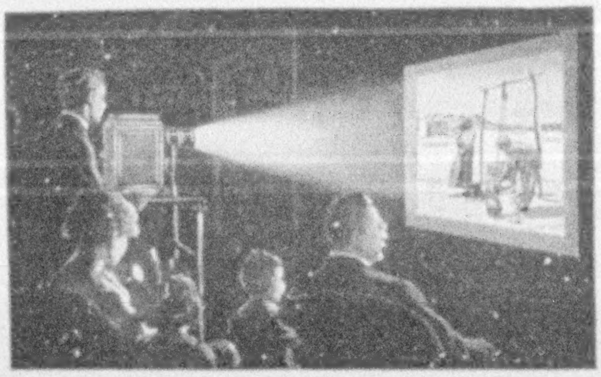

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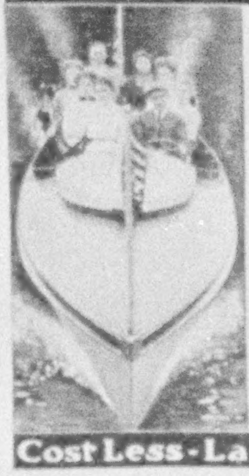

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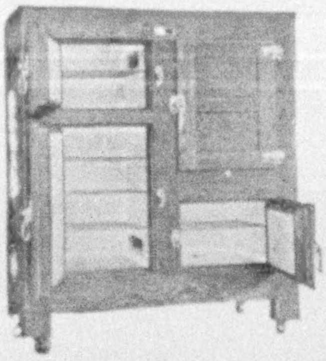

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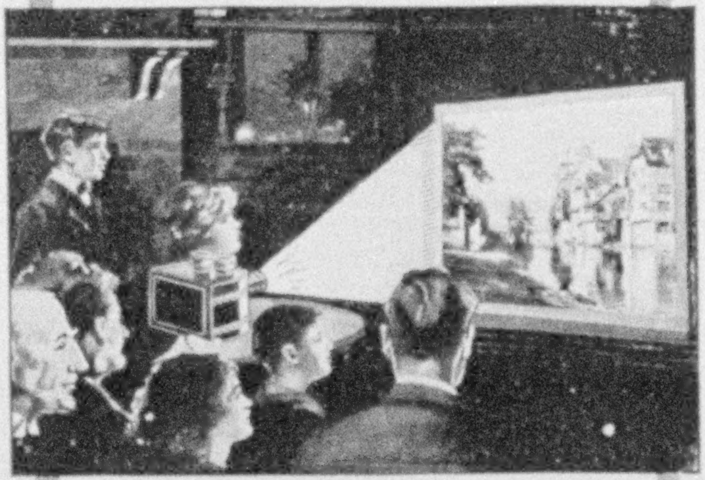

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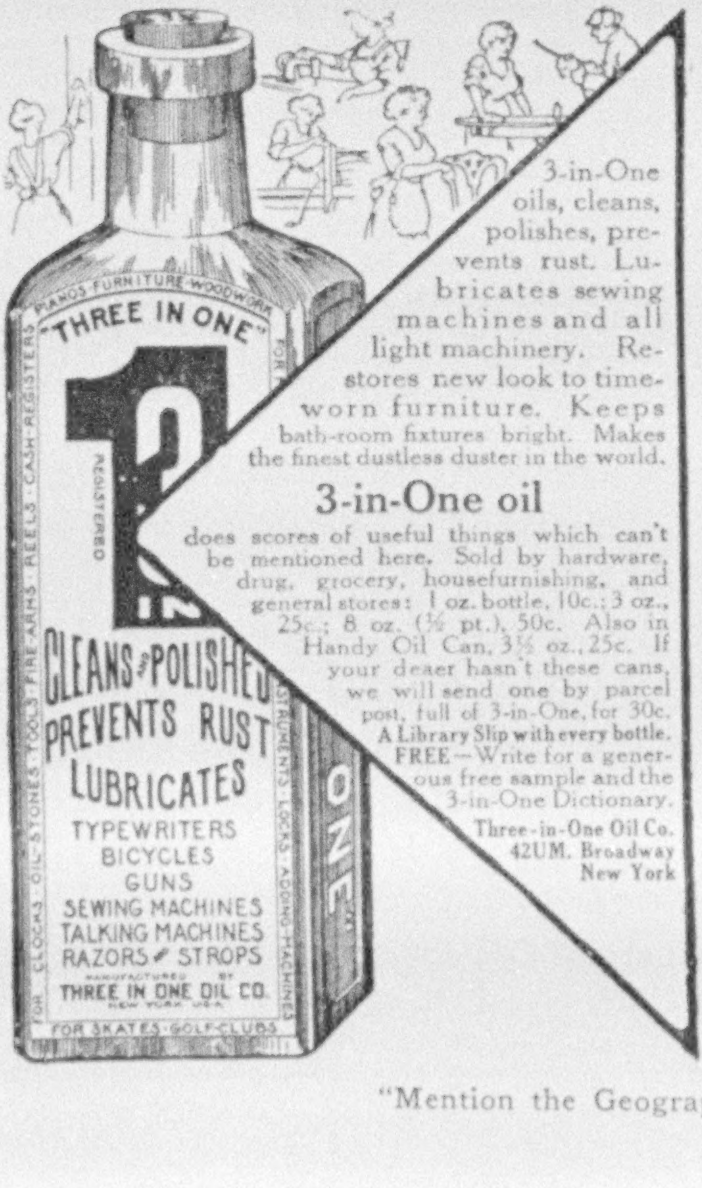

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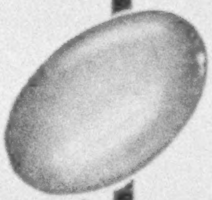

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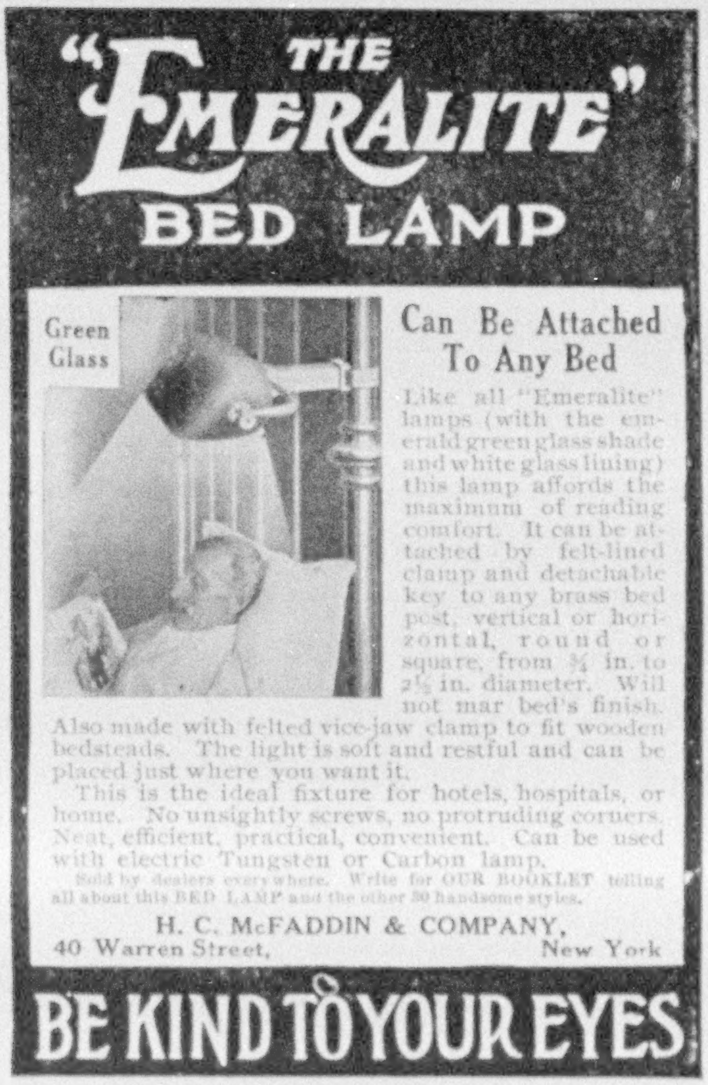
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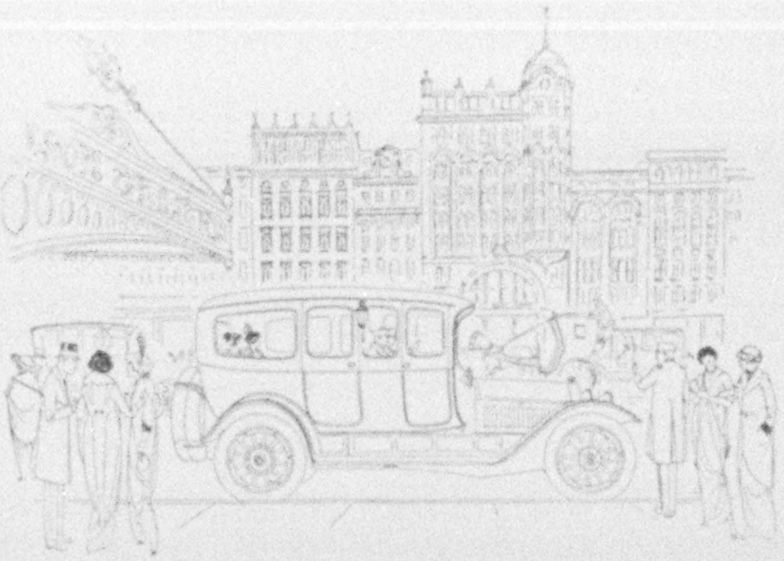

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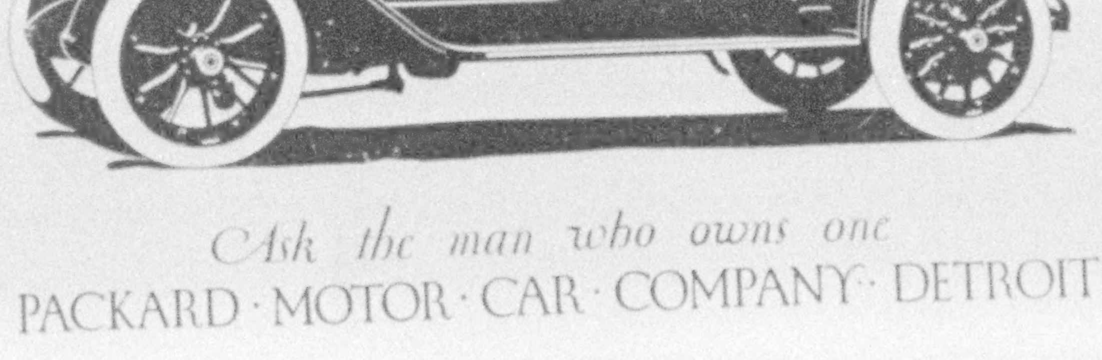

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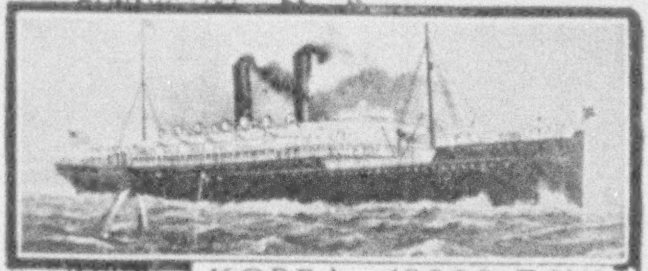
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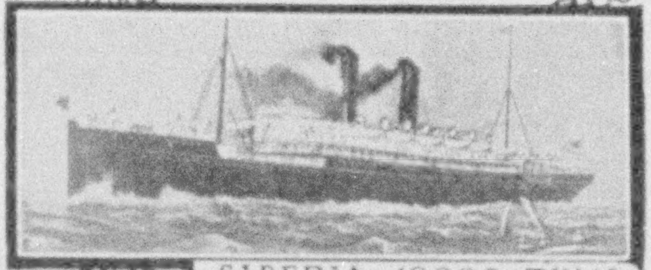
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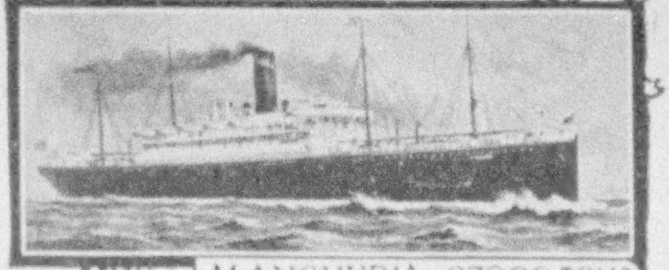
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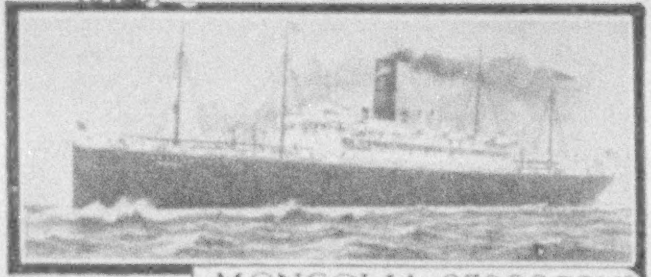
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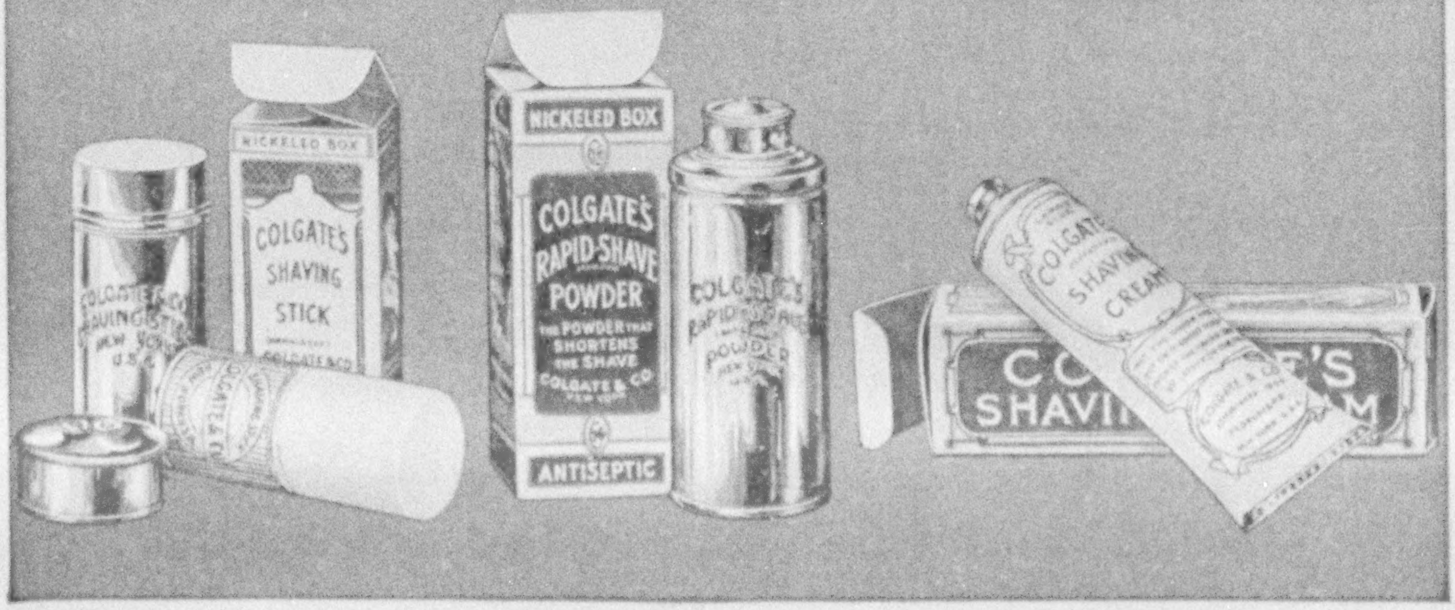
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